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ABSTRACT

A theory of interaction between college students and college faculty based on similarity in style of intellectual functioning was proposed, instruments to measure student and teacher characteristics were developed, and the relationship between achievement and intellectual style similarity was studied. Studies that focus on the impacts of physical, social, and intellectual environments on the interaction between student and teacher are reviewed. Two scales were developed to measure cognitive style: Student Goal Orientation scales and Staff Role Orientation scales. Pilot testing of the scales and reliability, validity, and other measures of their quality are described. The study was conducted with 287 students and 30 staff of a university physics department. It was found that the greater the degree of similarity in student goal orientation between student and lecturer, the greater was the student's achievement, as measured by that lecturer. Additionally, there was no relationship between similarity in staff role orientation between student and lecturer and that student's achievement, as measured by that lecturer. Implications of the findings for further research and for tertiary teaching are considered. Study instruments and related articles are appended. (SW)

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STAFF-STUDENT INTERACTION AT TERTIARY LEVEL

A Study of Staff-Student Cognitive Style Similarity and Student Achievement at Tertiary Level

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Submitted in fulfilment of the requirements of the Degree of

Doctor of Philosophy

Faculty of Education

1976

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Staff-Student Interation at Tertiary Level

A Study of Staff-Student cognitive style similarity and Student achievement at Tertiary level

SUMMARY

This study seeks to further the understanding of variations in achievement of an individual at tertiary level. The study is in four major sections:

1) The development of a theory of interaction, based on previous studies, communication theory and learning theory. This leads to the development of a major hypothesis relating congruence in style of intellectual functioning to student achievement.

The hypothesis states that the greater the similarity in style of intellectual functioning between student and staff member, the greater will be that student's achievement as measured by that lecturer.

2) The development of instruments to measure cognitive style is dealt with in some depth, from theoretical definitions, pilot trials and subsequent extensive validation.

The measures are based mainly on studies of student typologies and staff typologies, thus there are two forms, one directed at student intellectual values (The Student Goal Orientation, SGO, scales), the other at staff values (The Staff Role Orientation, SRO, scales).

3) The testing of the hypothesis in a natural experiment. The study was conducted with a sample of 287 students and 30 staff of a University Physics Department. The hypothesis could only be tested with three of the five year groups of students, reducing the number used to test the hypothesis to 116. Only 13 of the staff actually taught these students.

Two major hypotheses were tested with each of the three groups, each expressed in the same terms, but differing in the measure of style of intellectual functioning. (SGO and SRO). The hypotheses was supported for the SGO scales with each group, but not for the SRO scales in any group.

4) A discussion of implications of the findings, completes the thesis, dealing with the limitations of the study arising from experimental and other considerations, the implications of the study for further research, and the implications of the findings for teaching at the tertiary level.

The external validity of the research design is substantiated, enabling reasonably broad generalizations to be educed.

The results suggest that as congruence on SGO is important and not SRO, the critical aspect for the student is not the way a lecturer sees his role, but that the lecturer shares his concept of the goals of a tertiary education. There are more obvious conclusions to be drawn. The lack of feedback opportunity in the traditionally taught lecture course can enable misunderstanding to develop unchecked, resulting in levels of achievement that partially reflect interpersonal congruence. This source of invalidity in the educational process could be reduced by a range of activites that foster interpersonal understanding. No attempt is made to ascertain the relative impact of SGO congruence or different elements of a students' education (the learning situation and the assessment situation), nor is any study of behavioural differences between 'types' of student or teacher undertaken. These are referred to later studies.

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the candidate's knowledge and belief, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Russell Alan Docking

4 February 1976

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CHAPTER 1

INTRODUCTION

> The quest for the golden fleece was no more arduous than the quest for measures predicting academic achievement. (McKeachie, 1961, p.111).

> Until very recently, the approach to the analysis of teacher-pupil and pupil-pupil interaction in the learning situation was that of examining and quantifying certain 'monadic' variables, such as the teacher's training and experience, the learners' socioeconomic status and intellectual capacities, the goals of the school and community, and the materials provided to help achieve those goals. The examination of such variables has tended to be unrewarding and sterile. Researchers thus tried to examine social processes and interactions through static means. It was long believed that if we manipulated one or two variables, we could create conditions that would ensure both predictability and control of the quality and type of learning. Much experience has shown that this expectation is unsupported, that variables in the learning situation interact with each other in kaleidoscopic complexity, and that specification of the interactions and outcomes is extremely difficult.
> (Withall and Lewis, 1963, p.708)

The elusiveness of simple explanations of student performance is evidenced by the great number of studies conducted in the area, the range of conflicting results and alternative theories, and the frequent expressions of frustration of the kind cited above.

The sense of urgency in this quest for understanding is a characteristic of educational research at all levels, from pre-school to tertiary - stimulated by the idealistic desire to know, and the pragmatic needs to justify costs and promote efficiency.

The issues raised by Withall and Lewis reach their peak of complexity in the tertiary environment - the variations encountered in teacher learner and environmental variables are so great that meaningful empirical research is most difficult. For example, it is not unusual to find in a group of four hundred students ostensibly taking the same course of study, only a few groups of ten or more taking precisely the same combination of subjects, such is the diversity of options open to them. The sampling problems created by such hetrogeneity are insurmountable.

The courage of those battling such odds is to be admired, but their work often leaves one no better informed than one is from one's own experience. Attempts to integrate and correlate the wide ranging studies and findings tend to raise more questions than answers. They are forced to link armchair hearsay with carefully controlled experiment in an uneasy and often fruitless marriage. Such writers as Feldman and Newcomb (1969),Parkyn (1959) and Miller (1970a) have produced comprehensive volumes in this area, but their findings are inconclusive.*

Feldman and Newcomb in particular are aware of these problems:

> Among the major obstacles facing the researcher in this field - for college impacts are intricately multivariate - are problems of methodology. Most of the older studies, and even many of the recent ones, do not take adequate account of the possible pitfalls. The resulting misfortune is not so much that their findings are wrong as that they cannot be interpreted: often one simply cannot judge whether impact can be inferred from the data. For such reasons we felt that we could not entirely

---

* At the time of commencement of this study, 1970, their books represented the most comprehensive studies of achievement at tertiary level. Review of the primary sources discussed in these volumes show their interpretations and precis to be largely correct, and this chapter therefore rests heavily on these three secondary sources, and on readings of primary sources since 1970.

> sidestep the 'technical' issues that are crucial for drawing inferences from data. And, since we ourselves are not infallible, we freely have presented summary tables of 'raw' findings in a second volume, so that the interested reader can decide for himself about the legitimacy of the inferences we have drawn. (Feldman and Newcomb, 1969, p.2).

They complete the study with nine propositions that are, by their own admission, very general and often impressionistic. They are obliged to comment that 'our own interpretations and fore glimpses therein are not, we believe, inconsistent with the research findings considered in earlier chapters - but neither do they in every instance follow inevitably from those findings'. (Feldman and Newcomb, 1969, p.326).

The researcher approaching such an area for intensive investigation must be aware that the dice are loaded against him, that others before him have either failed, or have produced findings that do not fit any consistent framework. To found a thesis on the mistakes of others becomes a daunting task, but the need to know and the potential pragmatic rewards dictate that the goal must once again be attempted.

In general terms, researchers have focussed on personal variables, such as student and staff attributes, institutional variables, or on the dynamic interaction between them. The variable on which most effort has been focussed is student achievement however defined (grades, attitudes, attrition, or standardised tests, for example) and no apology needs to be made for this because it can hardly be disputed that tertiary education institutions have as a major function, the facilitation of the achievement of a wide range of objectives. The criterion of this particular study is academic achievement and it is in relation to this outcome that the various classes of variables will be discussed.

1.1. Personal Variables and Student Achievement

Studies dealing with the relationship with achievement and a wide range of variables have been conducted at all levels of education, and have been reported by Feldman and Newcomb (1969), by Miller (1970) and others. (See Table 1.1.).

There is quite a bit of interdependence between some of these variables (for example, intelligence and past school results) and this, coupled with widely divergent sampling, measurement techniques and experimental settings has resulted in a very confused collection of findings. As Withall and Lewis have suggested, such studies tend 'to be unrewarding and sterile'.

A review of literature dealing with these variables and tertiary level achievement in particular produces quite anomalous results. For example, the importance of intelligence is variously reported as high as .58 (Eysenk, 1947) and as low as .19 (Parkyn, 1959), and past performance as high as .77 (Williams, 1950) and as low as .15 (Parkyn, 1959). Of course, these figures reflect in part different disciplines and different measurement criteria, and the confusion that surrounds their interpretation.

Table 1.1.

Some Studies in Correlates of Achievement at Tertiary Level

Variable	References
Age	Miller (1970a)
Ambition	Miller (1970a)
Anxiety	Miller (1970a)
Aptitude	Parkyn (1959), Jones and Grieneeks (1970), Pemberton (1963)
Attitudes	Anderson (1965), Lewis (1970), Barreti-Fuchs (1975), Pemberton (1963), Mock and Yonge (1969)
Birth Rank	Miller (1970a)
Creativity	Yonge (1965)
Curiosity	Miller (1970a)
Ethnicity	Miller (1970a)
Extra Curricular Activities	Miller (1970a)
Finance	Anderson (1965), Miller (1970a)
Intelligence	Miller (1970a), Eysenk (1947), McKeachie (1961), Parkyn (1959), Yonge (1965)
Motivation	Hillman (1969), Yonge (1965), Miller (1970a) Kahoe and McFarland (1975), Entwistle (1968), Packwood (1973)
Parents' Occupation	Anderson (1965)
Persistence	Yonge (1965)
Personality	Gibbs (1965), Entwistle (1972), Yonge (1965), Miller (1970a), Jones and Grieneeks (1970), Barreti-Fuchs (1975), Sanford (1956), Middleton and Guthrie (1959)
Religion	Miller (1970a)
Residence	Miller (1970a)
School Achievement	Astin (1964b), Anderson (1965), Parkyn (1959), Humphreys (1968), Williams (1950).
School Subjects	TRU (1971)
Self-Perception	Jones and Grieneeks (1970), Saviki, Schumer and Stanfield (1970)
Sex	Miller (1970a), Skager and Braskamp (1966)
Socio-economic-status	Miller (1970a), Musgrove (1967)
Study Conditions	Anderson (1965), Miller (1970a), Entwistle, Nisbet, Entwistle et al (1971)
Workload	Anderson (1965)
General	Yonge (1965), Feldman and Newcomb (1969), Miller (1970a), Richards, Holland and Lutz (1967), Robinson (1969), Schonell, Roe and Middleton (1962), Wankowski (1969), Entwistle and Brennan (1971), Anderson (1961), Mayhew (1965).

Studies have also been conducted that relate student achievement to such factors as teacher personality, qualifications and teaching style. Feldman and Newcomb review studies up to 1969, and a search of the literature since that date has confirmed their finding that there is little consistent evidence of the impact of faculty on students. Miller's book 'Success, Failure and Wastage of Higher Education' (1970) also fails to provide any definitive results. Yet all authors maintain that there must be an important impact that affects achievement.

The reviews of Feldman and Newcomb (1969, and Miller (1970a), and the reading of subsequent papers does little to reduce the uncertainty surrounding this area. Their heroic attempts to combine a wide range of studies into a meaningful whole has left them and their readers quite frustrated.

Feldman and Newcomb hint at the limited significance of Faculty in their fifth conclusion:

> 5. Though faculty members are often individually influential, particularly in respect to career decisions, college faculties do not appear to be responsible for campus-wide impact except in settings where the influence of student peers and of faculty complement and reinforce one another.
> (Feldman and Newcomb, 1969, p.330).

The failure of personal variables to account adequately for academic achievement is borne out by Miller's plea for more study of institutional variables:

> Research into student variables should continue, but the literature has made us uncomfortably aware that campus and departmental values may be just as critical a factor in wastage as student variables.
> (Miller, 1970a, p.227).

and also:

> Wastage or attrition in higher education is a major problem. The studies reviewed in this volume are a fair representative sampling of the literature. The main streams of research have been covered, and the indications are clear. Research on wastage, to be effective, must take into account institutional and departmental variables as well as the very wide range of variables more closely related to the student.
> (Miller, 1970a, p.252).

The section that follows takes a brief look at the productivity of such research.

1.2. Institutional Variables and Student Achievement

A good deal of attention has been directed towards institutional and 'objective' factors influencing achievement. The work of Astin (1962) has been particularly forceful in their attempts to relate institutional variables such as size, sex ratio, policy, locale, discipline balance and entry requirements. Some of the problems associated with this type of research focus are discussed in Chapter 2, but suffice it to say here that in terms of the individual student, the impact of variables such as these would be hard to ascertain or interpret. None of Feldman and Newcomb's nine conclusions relate specifically to an institutional dimension, except insofar as it may encourage staff/student contact.

Along with these variables one can consider variables relating to the school environment. Research suggests that the unique contributions of different types of schools, after one has controlled or accounted for differences in ability of students is not significant (for example, see the TRU report, 1971).

Institutional variables are fraught with difficulties arising from bulk measures, self-selection (and non-random sampling), definition of standards and criteria, the inter-relationship between variables, policy structures and the real importance of so called 'objective' measures. Critical questions of cause and effect are unanswered or unanswerable. It is a line of research that is particularly fruitless. The 'kaleidescopic complexity' of the variables in the learning situation forces one to look further than the simple 'direct effect', to interactions.

> One possible partial explanation for the meager findings in both these areas is that teaching methods effect different students differently.
> (McKeachie, 1961, p.111).

1.3. Interaction of Variables and Student Achievement

There are a number of 'interactive' dimensions that can be viewed, viz:

Student-student	the study of peer relationships
Student-staff	the study of student-faculty relationships
Student-university	the study of student fit
School-university	the study of school to university transition

Each of these foci have support and opposition. Feldman and Newcomb (1969) reporting on student-student impact state that the peer group produces conformity and diversity, but no trends are evident that relate to achievement.

The concept of student-university fit is one explored deeply by Stern (1970) in his application of Murray's Needs-Press theory with his College Characteristics Index (C.C.I.) scales. These have aided our understanding of inter-institutional differences, but do not offer real directives to individual person/environment fit. Pervin 1967b) argues that the work of Stern does not actually consider interaction. He supports a technique of transactional analysis in his work with TAPE. Hunt (1975) attacks the apparent loss of interest in studies based on person/environment interaction:

> Person-environment interaction poses a very complex and demanding problem, and it is, therefore, understandable that resistance has developed to acknowledging, or even perceiving, this challenge.
> (Hunt, 1975, p.210).

He urges a return to this type of research, based on adequate theory and measures.

We will return to the concept of environment-person interaction in this study, but via the concept of the person created environment rather than a concept of environment as a static phenomenon. This follows very closely the conclusion reached by Pervin (1967b) after an extensive and comprehensive review of literature dealing with interaction theory.

School to university transition has been studied widely, but no definitive results have followed. Quite obviously the change is great for all students, and minor variations in School environment are swamped by the massive school-university environmental change.

Student/staff interaction has been studied on a number of fronts - notably observable staff-student interchanges using content analysis techniques (e.g. Flanders, 1951) or on the origin of these messages. Flanders type analysis are more commonly conducted at Primary or Secondary level, but rarely at tertiary level, where there is traditionally less opportunity for dynamic two-way interaction. Consider Figure 1.1.

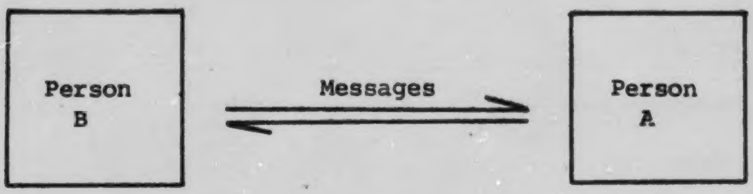


Figure 1.1.

Primitive Communication Model

This primitive communication model reminds us that one can focus on the messages or on the interacting persons. Study of the messages requires an understanding of the environment, as behaviour is dependent on that variable. It is reasonable, therefore, to concentrate on the sender and receiver of the messages, assuming the messages, verbal or non-verbal, to be consistent with some construct (perhaps personality).

Lewin's formula $B = f(P,E)$ where B is behaviour, P is personal variables, and E environmental variables, tells us that if E is constant then $B = g(P)$. A study of B (as in the Flanders type analysis) would suffice if one could be sure one was observing the relevant behaviours. The study of Personal variables (P), while still subject to the problem of selection of relevant components, offers the opportunity to understand and account for all B, readily observable or not. This rationale is the one underlying the use of projective tests, where under controlled conditions (E) behaviours (B) are observed from which Personality can be inferred (P), which will in turn allow inferences to be made beyond the range of observation of the psychologist. In like manner, interaction studies offer greatest hope of validity if an attempt is made to determine relevant underlying variables (P) rather than environment specific, non-random behaviours (B).

What personal variables are relevant? Many studies have tried to optimise teacher-student fit - generally on readily available personality scales, or on other background dimensions (S.E.S., colour/race, etc.) with varying success (Cunningham, 1975). The studies tend to be correlative and post-hoc, based on a given set of results rather than theoretically based.

Feldman and Newcomb draw our attention to the fact that:

> There are certain areas of student values and behaviour that do not particularly concern the faculty and where faculty values are more or less irrelevant - sexual and other private matters, for example. We shall therefore restrict our analysis of the compatability of student and faculty impacts to academic and intellectual matters.
> (Feldman and Newcomb, 1969, p.259).

Even this narrowing down of the field is not enough. If one uses variables on which there are clear cut staff-student differences (i.e. the staff as a group are clearly different from the students as a group), then the likelihood of detecting differences between staff for individual students is reduced. Such a variable may be an important one for staff/student communication generally, but it offers little potential value in aiding our understanding of individual student/staff interactions.

1.4. Principal Focus of this Study

When a student undertakes a course of study, he is absorbed into an intellectual environment, the nature of which reflects certain personal properties of the lecturer running the course. The syllabus, the text, the lecture series, the experiments, the tutorials, the examination, all reflect characteristics of the lecturer in a complex incomprehendable way. The student, bringing to that environment his ways of behaviour that reflect his personal characteristics, responds to that environment in a manner that cannot always be itemised or observed. He may not be able to verbalise his reactions, nor identify those components of the environment that influence him.

McKeachie describes such an effect as follows:

> The teacher's behaviour is important not only in the initial cues it provides to motives and habits, but also in the continuous shaping of instrumental responses and motives of students which goes on in addition to the type of learning assessed in course examinations.
> (McKeachie, 1961, p.118).

The result of mismatch between expectations and actual teachers' behaviour is described by McKeachie.

> In addition to such general expectations the student develops specific expectations about the likely satisfactions and appropriate instrumental behaviors in his college classes. The cues provided by his instructors thus may activate motives or skills already active, may frustrate expectations previously elicited by the total environment, or may arouse uncertainty and anxiety about the likelihood of success or failure in reaching his goals.
> (McKeachie, 1961, p.115).

The student is studying a range of courses, under one or many lecturers, and is therefore subject to a range of relatively independent environments. Does he react differently to these environments? Do some suit him better than others? The focus of this study is basically on this question. More specifically, do the marks awarded to a student by his lecturers reflect the degree of fit between the student and each of these lecturers?

Quite clearly, since no single feature of the intellectual environment created by the lecturer can be singled out as the operative factor, environment may not be referred to as an independent variable, but rather as being dependent on the lecturer's intellectual style or cognitive frame of reference.

1.5. Outline of the Thesis

In this chapter, some indication is given of the current state of confusion surrounding the search for correlates of achievement, and an alternative approach which seeks to subsume a range of specific behaviours (observable and unobservable) and components of environment and relate them to certain internal states of teacher and student.

Chapter 2 reviews studies conducted in the field of environment in communication impact studies. The chapter is structured around four main problems, and gives indications of possible solutions.

Chapter 3 introduces a natural experiment conducted to test the hypothesis relating achievement to intellectual style similarity. The chapter describes the theoretical framework on which the hypothesis is based, and the research design necessary to test it.

Chapter 4 describes the development of instruments to measure the underlying characteristics hypothesised to be responsible for the creation of characteristic learning environments, or the interaction with them.

Chapter 5 provides extensive evidence of the validity, reliability, efficiency and unreactivity of the scales.

Chapter 6 completes the experiment, reporting the analysis and the findings.

Chapter 7 concludes the thesis, with a summary of findings and suggestions for further study.

CHAPTER 2

PREVIOUS RESEARCH

The interaction between student and staff member is a component of the intellectual environment at an educational institution. Studies that focus on impacts of environment, whether it be physical, social or intellectual can be reviewed generally as environmental impact studies.

A great deal of attention has been directed towards the study of college or university environmental impact - but to date no study has produced consistent or meaningful findings. There are four main reasons for this situation:

1. The lack of theoretical frameworks relating output to environmental and input variables.
2. Problems involved with the statistical and research models involved in the studies.
3. The lack of validity or meaningfulness in the measurement and definition of environments.
4. Problems related to the definition and measurement of achievement.

These four areas provide the structure for this Chapter. It could be said in advance that at least one of these problems apply to every study previously undertaken in this area and so none can be regarded as the epitome of research into environmental impact and achievement. These issues will all be dealt with again in later

Chapters, as this thesis unfolds to demonstrate the fidelity of this research on these issues:

1. Theoretical framework - Chapter 3 (Theory and Design).
2. Statistical and research models - Chapter 3 (Theory and Design).
3. Meaningfulness and validity of environmental measures - Chapter 4 and Chapter 5 (Instrumentation).
4. Measurement of achievement - Chapter 3 (Theory and Design).

2.1. Theoretical Frameworks

It is trite to say that impact is a logical, expected outcome of the tertiary educational experience. There are, it is often argued, only three components in the interaction -

Input variables
Environmental variables (includes inter-personal environment) and
Output variables

Attempts to explain the mechanics of the interaction of input/ environment to produce output are rarely found, apart from rather lame statistical explanations (cf Path analysis).

Astin (1970,a) reports concern for the lack of theory in interaction research (p. 241).

> Assessing interaction effects presents many methodological problems, primarily because the number of possible student-environmental interaction effects is so large. Simply to 'shotgun' the study of interaction effects by generating all

possible combinations is usually unrealistic either because of the large loss in degrees of freedom or because of limits on the number of variables that can be accommodated in a given analysis.

Perhaps the most common approach is to generate only those interaction terms suggested by a particular theory. However, the paucity of comprehensive theory in this field greatly limits the range of interaction terms that one can explore in this manner.

There exist a range of models of student-teacher interaction that are of potential use. In this study, one must be identified or developed that relates student inputs and staff inputs to student outputs. There are cybernetic models and flow diagram models (paradigms) to consider. Cybernetic models parallel the logic of the computer to the thinking processes involved in teaching. This is done for two reasons -

(1) develop teaching machines; and

(2) to represent the teaching/learning process in terms of a logical process that machines can simulate.

Such a paradigm, developed by Stolerow (1961) reported in Gage (1963) is rather one-sided as it is more concerned with the decision making processes of the teacher, and offers little to the study of teacher/student interaction.

Of greater impact are paradigms based on the effectiveness paradigm. One such refinement is represented by the work of Mitzel (1957) also reported in Gage (1963). Mitzel divided the relevant variables into four groups, as shown in the Figure 2.1.

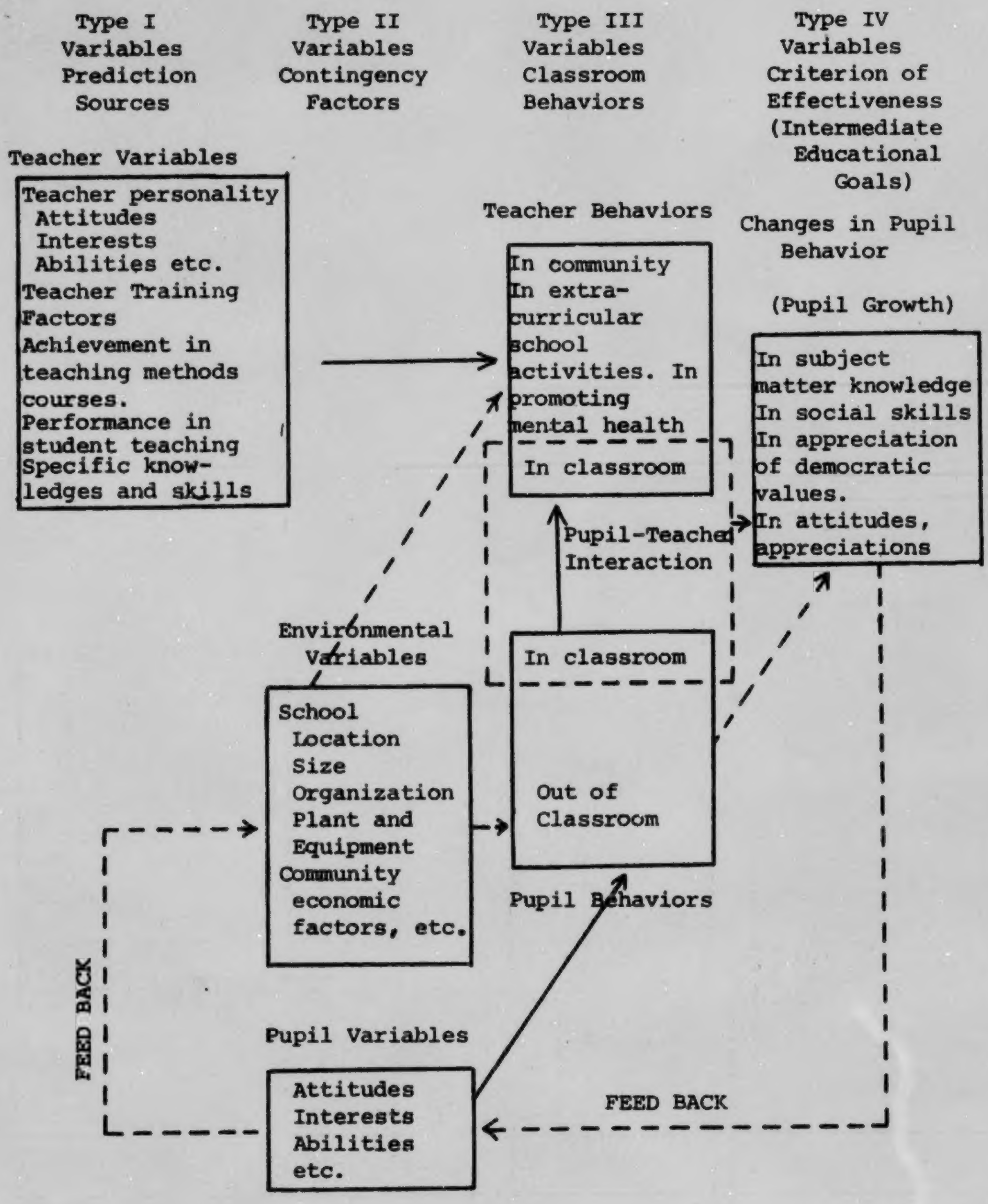

Type I Variables Prediction Sources
Type II Variables Contingency Factors
Type III Variables Classroom Behaviors
Type IV Variables Criterion of Effectiveness (Intermediate Educational Goals)
Teacher Variables
Teacher personality
Attitudes
Interests
Abilities etc.
Teacher Training Factors
Achievement in teaching methods courses.
Performance in student teaching
Specific knowledges and skills
Teacher Behaviors
In community
In extra-curricular school activities. In promoting mental health
In classroom
Changes in Pupil Behavior
(Pupil Growth)
In subject matter knowledge
In social skills
In appreciation of democratic values.
In attitudes, appreciations
Pupil-Teacher Interaction
Environmental Variables
School
Location
Size
Organization
Plant and Equipment
Community economic factors, etc.
In classroom
Out of Classroom
Pupil Behaviors
Pupil Variables
Attitudes
Interests
Abilities
etc.
FEED BACK
FEED BACK

Figure 2.1

Generalized Schema for Research in Teacher Effectiveness
(Mitzel, 1957, reported in Gage 1963, p. 119)

Solid lines are used to describe direct interactional effects, dotted lines indirect effects. This model makes two important inferences -

(1) Pupil growth is the outcome of pupil/teacher interaction;

(2) Pupil/teacher interaction is directly dependent on teacher and pupil variables.

It follows that the study of teacher/pupil impact can be contrived as follows (Figure 2.2).

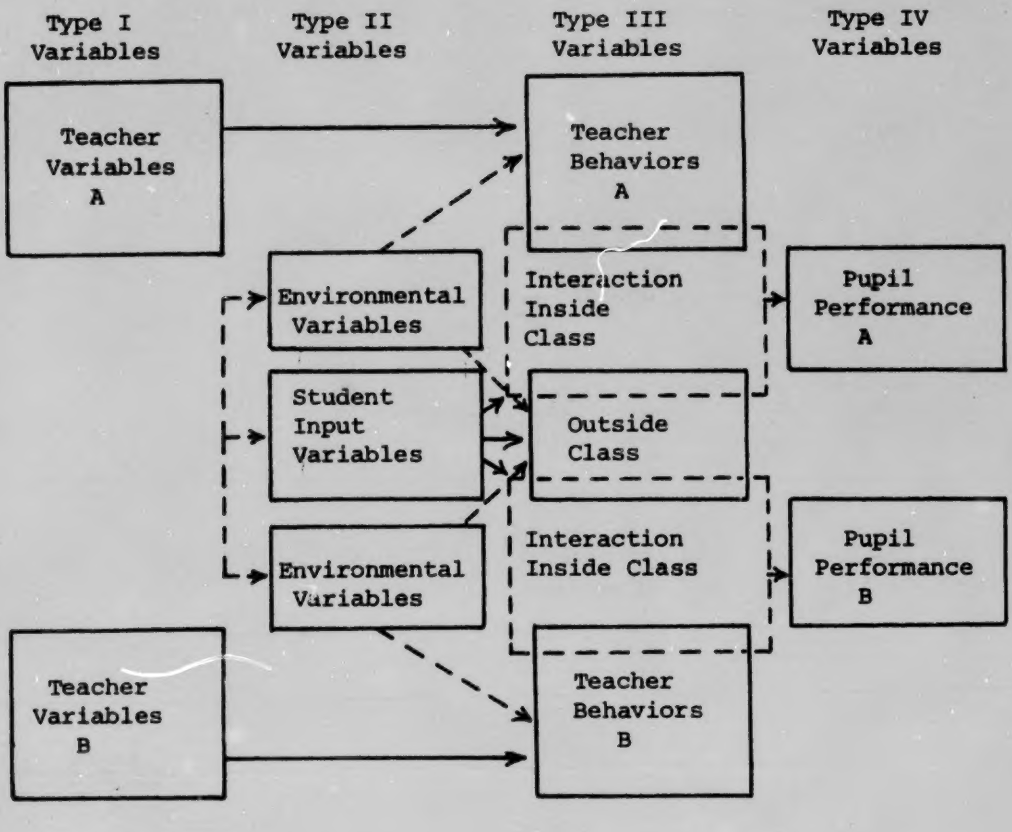

Type I Variables
Type II Variables
Type III Variables
Type IV Variables
Teacher Variables A
Teacher Behaviors A
Environmental Variables
Interaction Inside Class
Pupil Performance A
Student Input Variables
Outside Class
Interaction Inside Class
Pupil Performance B
Environmental Variables
Teacher Variables B
Teacher Behaviors B

Figure 2.2

Paradigm for Research into Teacher Effectiveness
(Adapted from Mitzel, 1957)

This enables one to compare Type I variables with Type IV variables holding Type II variables constant. Mitzel applied his model of the teaching/learning process to a study reported in 1957. Smith (1960) described a model which is readily adaptable to the tertiary teaching situation, and which also offers a definition of achievement. The model is illustrated in Figure 2.3.

$$||Pt \rightarrow Dt \rightarrow Rt \;| \rightarrow Pp \rightarrow Dp \rightarrow Rp|| \rightarrow Pt \rightarrow Dt \rightarrow Rt| \rightarrow P; \rightarrow Dp \rightarrow Rp||$$

$$\ldots\ldots\ldots \rightarrow \text{achievement}$$

where letters P, D and R stand for Perception of behaviour Diagnosis of state of interest,and Response to D

and subscripts p and t refer to pupil and teacher

and | separates 'teaching' from taking instruction and || separates teaching episodes.

Figure 2.3

Smith model of teaching/learning

The adaptability of this model to tertiary education is simple if one considers the form of traditional learning. Here, the episodes are repeated without necessary flow on, because of the lack of opportunity for student feedback. Hence we have:

$$||Pt \rightarrow Dt \rightarrow Rt| \rightarrow Pp \rightarrow Dp \rightarrow Rp||$$

$$||Pt \rightarrow Dt \rightarrow Rt| \rightarrow Pp \rightarrow Dp \rightarrow Rp||$$

Note the linkage between episodes, present in the original model is not used. This suggests that Pt and Dt are not likely to be changed with Rp.

Achievement can also be defined by this model, shown vertically below.

—
Pp pupils perception of teacher behaviour (Examination paper)
↓
Dp pupils diagnosis of teachers state of interest (goals)
↓
Rp reaction of pupil (pupils answers to paper)

—
Pt teacher perception of students behaviour (answers)
↓
Dt teachers diagnosis of pupils state of interest (interpretation)
↓
Rt reaction of teacher (marks awarded).
—

Achievement is therefore defined as a component of interaction in itself. Questions of test validity, examiner bias etc. do not arise as they are themselves an integral part of the interaction.

There is no guidance, however, about specific differences in learning arising from interactions. The models only describe antecedent and environmental variables that potentially influence achievement. No mechanism for this is described.

Formal learning, which is our concern here, involves communication between teacher and student, so communication theory may provide a clue to the processes that influence learning.

Anderson (1965) makes the observation:

> At the root of student problems is a breakdown of communication as it affects the learning process. (p.129)

and also

> Students difficulties are increased by a failure in the channels of communication in the university - from teacher to student, student to teacher, student to student, and teacher to teacher. (p.140).

Work using communication theory and linguistics has been done on teacher/student interaction by many researchers, (for example, Fulcher and Anderson, 1975). In these studies, observational techniques are generally used to quantify and categorise verbal interchange between student and teacher. There are two serious difficulties with this approach.

1. The interchanges observed may not be an adequate sample for cause and effect relationships to be inferred. The development of attitudes or ability may be a spasmodic behaviour, in which case the relevant interchange may not be observed, or it may be a gradual, continuous process, and sample observations would be invalid.

2. The classification and focus of study may not be relevant. Studies have concentrated on question/answer types, degree of directiveness etc. as if these were isolated elements of behaviour, independent of each other in origin and effect. Such an approach may result in myriad elemental variables that while related to achievement increase the complexity of our understanding rather than simplify it. Furthermore, large

sections of potentially important behaviour may be ignored (as the non-verbal once was) simply because these appear as a priori grounds for significance.

There are, of course, other problems - those of observer reliability and bias, and observer/subject interaction. (For a detailed discussion of observational techniques see Medley and Mitzel, 1963). We can consider the communication situation in terms of Figure 2.4.

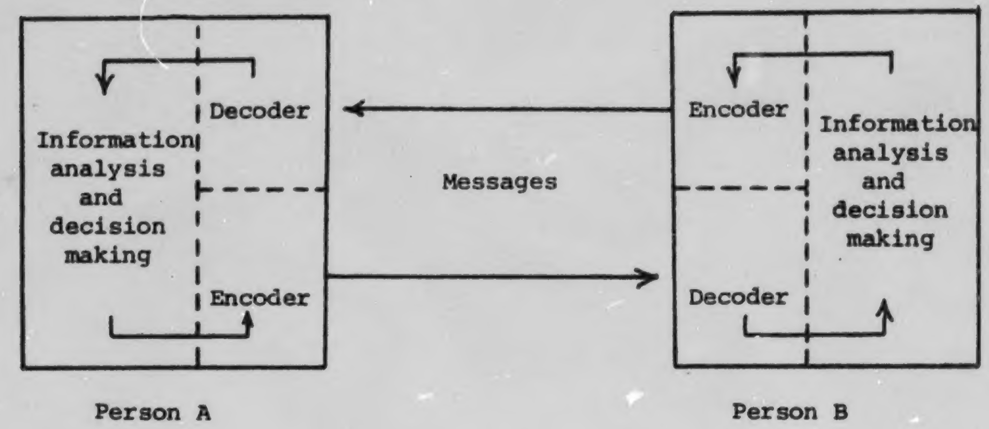

Decoder
Information analysis and decision making
Encoder
Messages
Encoder
Information analysis and decision making
Decoder
Person A
Person B

Figure 2.4

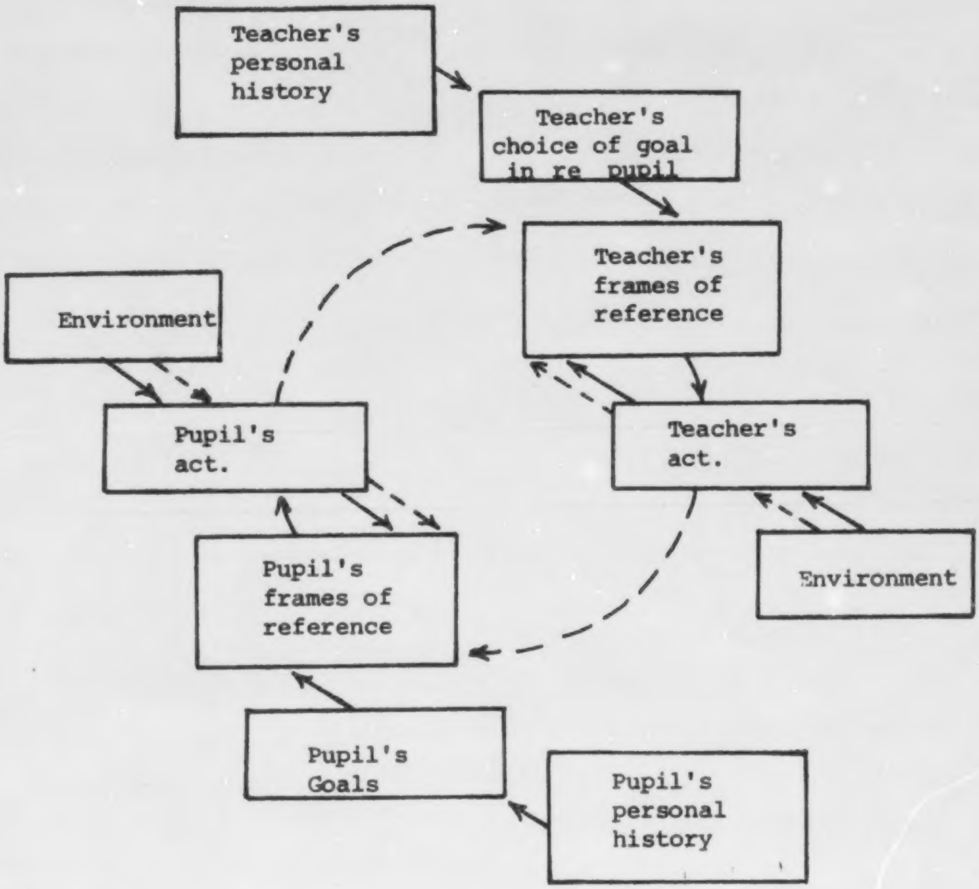
Schematic Model of Interaction

The studies described above tend to concentrate on the messages, and, as mentioned, are sensitive to sampling and observational errors, as well as distortion through noise. This approach, founded on behavioural psychologies tends to ignore internal functioning and is therefore unable to make inferences about 'interpretation' or 'understanding'. Learning, in terms of the messages, is simply a matter of reinforcing one sort of message (the response) by another message (praise, acceptance etc.). If learning was as simple as this, then we would expect bulk efforts (actions) to be more important than individual effects (perceptions). The failure of the bulk behavioural approach will be discussed more fully in a later section, but an alternative can be suggested here. Figure 2.3 above illustrates two internal regions of the intellect of the participants - an encoding / decoding section, and an information processing section. The concept of an encoder/decoder is founded in information theory and psycholinguistics and provides the first firm body of theory relating interaction to learning. De Vito states the theory in these terms:

> To the extent that the codes of source and receiver differ, miscommunication will result. The source and receiver who speak different dialects, or even different languages, will miscommunicate to the extent that their codes differ. Put positively, they will communicate successfully to the extent that their codes overlap. In the case of dialects, the misunderstanding may be minimal; in the case of different languages it will be great.
>
> (De Vito, 1970, p.86).

The miscommunication of ideas, processes, or facts must lead to inappropriate learnings (in terms of the teachers expectations). This suggests that one should focus upon the cognitive structures involved in encoding and decoding messages, rather than the messages themselves. The overall theoretical framework should therefore involve such mediating variables.

Perhaps the most useful model of this kind in the tertiary education situation, is that proposed by Runkel, described in Gage (1963). Like the previous models this one is designed for the ongoing interaction situation, and expresses this by a cyclic design. (See Figure 2.5).

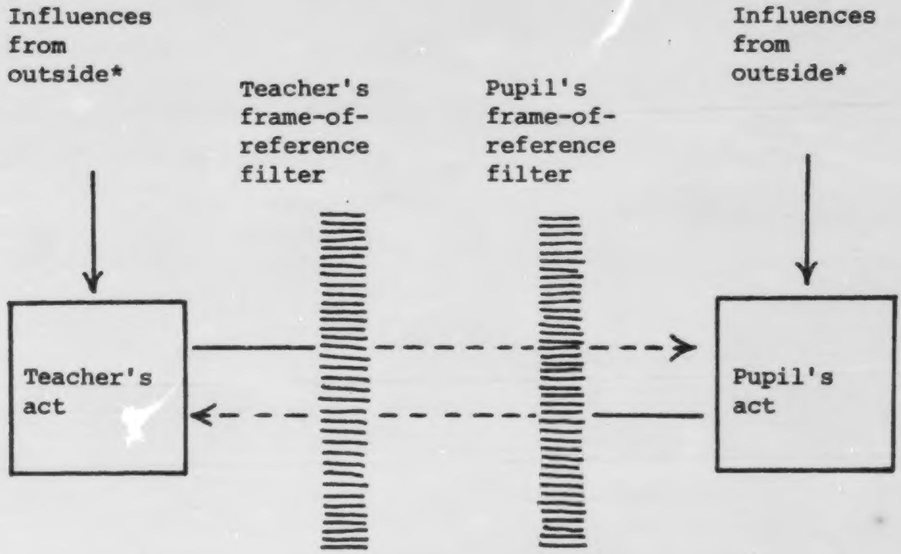

Teacher's personal history
Teacher's choice of goal in re pupil
Teacher's frames of reference
Environment
Pupil's act.
Teacher's act.
Pupil's frames of reference
Environment
Pupil's Goals
Pupil's personal history

Solid lines represent intrapersonal communication via the nervous system, etc. Dashed lines represent interpersonal communication via vision, speech, etc.

Figure 2.5

A brief model for Pupil-Teacher Interaction
(From Runkel reported in Gage, 1963, p.126)

The model allows for the adaption of teachers and pupils' frames of reference, is adaptable to the tertiary situation, and enables achievement to be defined in terms of interaction. The model incorporates an idiosynchratic concept of environment - that a person does not react to some objective measure of stimuli, but to their perception of it.


Influences from outside*
Teacher's frame-of-reference filter
Pupil's frame-of-reference filter
Influences from outside*
Teacher's act
Pupil's act

*Influences from outside the immediate interpersonal 'system' such as the individual's personal history, the immediate environmental happenings, etc.

Figure 2.6

Detail of the Runkel Model
(From Gage 1963, p. 126)

This enables learning to be related to perception, in that only congruent filters (encoders and decoders) will enable meaningful messages to pass. Runkel's model serves a number of very useful purposes, notably:

1. Enables learning to be related to perceptual congruence.
2. Enables perception to be measured validly.
3. Enables achievement to be defined validly.

In short, this model serves the need expressed at the beginning of this chapter, to a greater extent than any other model. The use of this paradigm will be discussed in the next chapter, and also in Chapter 6.

2.2. Statistical and Research Models

In a paper dealing with research methods related to college impact, Astin (1970) utilizes a simple model consisting of three components: Student inputs, the College Environment and Student outputs.

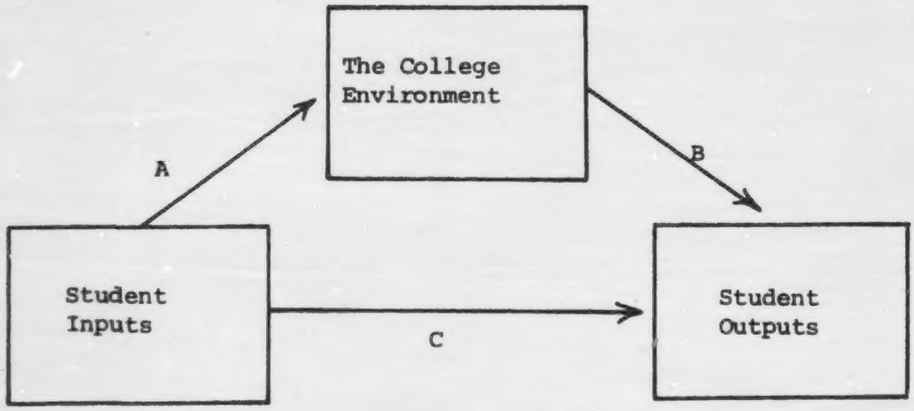


Figure 2.7

Astin's Model of College Impact
(Astin, 1970a, p. 225)

Astin describes the model in the following terms:

> The principal concern of research on college impact is to assess relationship 'B', the effects of the college environment on relevant student outputs. Relationship 'C' refers to the fact that outputs also are affected by inputs, and relationship 'A' to the fact that college environments are affected by the kinds of students who enroll.
>
> In addition to the 'main' effects of college environments on student outputs (B), the investigator, also may be interested in certain interaction effects involving student inputs and college environments. The diagram suggests that there are two types of interaction effects: those in which the effect of input on output is different in different college environments (AC), and those in which the effect of the college environment is different for different types of students (AB). Research on college impact ordinarily is concerned more with the second type. (Astin, 1970a, p.225).

This diagram can be modified to illustrate the three main forms of research on college impact. Variation I illustrates the type of study that compares student inputs with student outputs, holding environment constant.

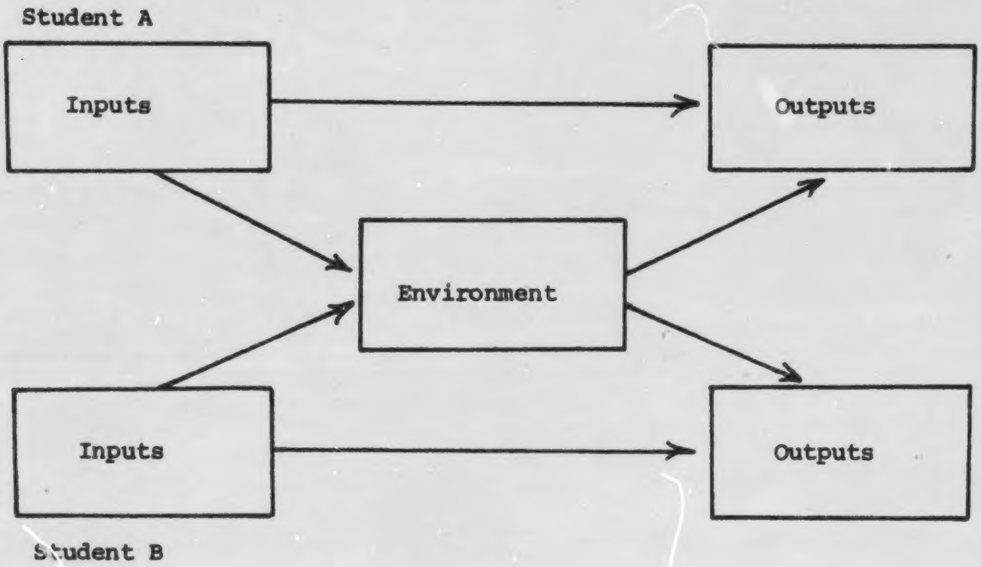


Figure 2.8

Variation I on Astin Model

Differences in output are ascribed to differences in input. Whilst causality is not implied, such studies are useful for prediction of probabilities of success of different applicants (selection) or for the modification of student inputs to improve the chances of success (remediation).

The methodological weakness of this approach lies in the assumption that the environment is uniform for all students.

There are a number of arguments against this assumption including:

(a) the impact of environment is phenomenological. The environment is an idiosyncratic variable related to the individuals' input variables, the behaviour of other individuals, and physical surroundings;

(b) the environment varies from student to student because of varying peer group attachments; and

(c) the environment differs because a student is not a part of the environment, yet he is a part of other students' environment. (This is particularly important for students at the extreme positions on variates of interest, and with small numbers of students).

Variation II compares student outcomes for varying environments. (See Figure 2.9.)

Differences in output can be ascribed to differences in environment if input differences are eliminated. Studies of this kind are useful for selection of institution purposes or the modification of environment to improve outputs.

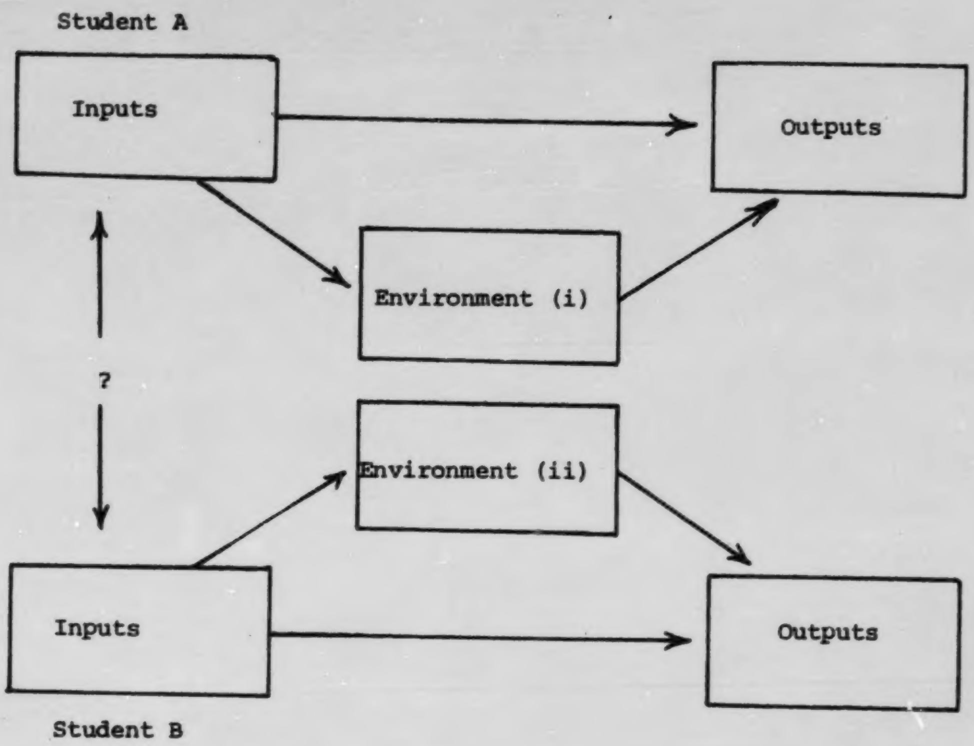

Student A
Inputs
Outputs
Environment (i)
?
Environment (ii)
Inputs
Outputs
Student B

Figure 2.9

Variation II on Astin Model

There is, however, a methodological weakness present in this model - arising from difficulties in eliminating input differences. Firstly, students do not assign themselves randomly to environments but base their choice on guided decisions involving estimates of their probable success or enjoyment. These may be at times on quite falacious information or reasoning, but nontheless, the populations of individuals in each environment are not likely to be equivalent. Random selection from these populations will not solve this dilemma. Secondly, the use of matching techniques can quite seriously bias the result, particularly if the matched samples come from different strata in their own groups. Astin describes this situation as follows:

> It is not generally recognized that research on interaction effects ordinarily employs a kind of matching design and therefore is liable to the same deficiencies. That is, if one sorts out his students in terms of attributes such as ability, sex, race, and so forth, his findings on the effects of college variables are likely to be biased by errors of measurement in these student attributes. For example, if students are satisfied by ability level (in order to detect possible interaction effects between ability and some college characteristic), the students in any given ability category will include representative subsamples of students from some colleges and highly nonrepresentative subsamples from others. Since the error of measurement in any student's ability test performance is likely to be correlated with the extent to which his score deviates from the mean score of his classmates (i.e. students with relatively high scores being more likely to have positive errors of measurement than students with relatively low scores), the 'superior' students from the least selective colleges are more likely to be spuriously high ability test scores (i.e., positive measurement errors) than are the 'superior' students from the most selective colleges. Thus, such studies may find that college selectivity, or some variable correlated with selectivity, 'affects' highly able students, when in fact there is no effect.
>
> (Astin, 1970a, p.234).

Feldman comments further on this problem of astin's model -

> One difficulty with the model, which it shares with any analysis attempting to isolate casual factors under conditions where 'subjects' have not been randomly assigned to 'treatments', is that logically one must find all relevant antecedent factors on which students differ on entrance to the several environments under study and adjust or control for the influence of these variables. This control may not prove possible. (Feldman, 1970, p.16).

This is not the only serious problem with this model. Feldman also points out that the interrelation of input and environmental variables can result in the underestimation of the importance of environmental variables. Of course, these problems do not arise simply from experimental design, but also from the statistical analysis method.

The most common technique is multiple linear regression analysis or related forms. Astin's technique attempts to partition interaction effects between output and input variables out of output variables and explores the relationship between the residuals in the output variables with the environmental variables. This overcomes much of the dispute surrounding the order in which input and environmental variables should be introduced into the equation, but is itself subject to problems, as Feldman notes:

> The two step, part correlation procedure advocated by Astin is most useful when the input and environmental variables are independent of one another. If, on the other hand, these two sets of variables are correlated, which is usually the case, the use of this particular input-output model can create certain problems. In the case of inter-relationships among input and environmental variables (technically, when there is multicollinearity), some proportion of the student outcome is due to the joint variation of student input characteristics and the college (environment) characteristics. The shared portion of variance in student outcome that could be accounted for by either set of variables is attributed to that set that is controlled initially (or which enters the initial regression analysis). Thus the input output model I results in attributing both the joint effect and the independent effect of input characteristics to the input characteristics; the college (environment) characteristics can only explain some proportion of the residual variance that is left .... Therefore, this particular input-output model, by first adjusting outcome by student inputs, overestimates the magnitude of the influence of inputs and underestimates the magnitude of the effect of college environments.
>
> (Feldman, 1970, p.16).

The further complicating factor is that once again, environment enters the equation as a common factor for all students. If phenomenological reasons of environment were taken, the correlation between input and environmental variables would increase to a point where this form of analysis would be meaningless.

There is another form of analysis found in the literature - Path analysis. This technique has the advantage that it forces one to specify a known or hypothesised model-specifying causality, direct and indirect variables. This is an advantage in that one disturbing characteristic of research in this area has been the lack of theoretically based models. Astin is critical of this technique on methodological grounds:

> Perhaps the major limitation of this method is that it can be unwieldy or even unworkable when the number of independent variables is large or when their temporal sequencing is not known. Since path analysis is more useful for testing specific causal hypotheses than for an open-ended exploration of college impact, its use probably should be confined to situations where the number of independent variables is relatively small, and where their interrelationships are relatively well understood.
>
> (Astin, 1970a, p.239).

whereas Feldman is generally supportive. (Feldman, 1971).

One is caught in a situation where one analytical technique - regression analysis - is unrelated to any specific interaction model, is susceptible to correlations between input and environment variables, but can handle a large number of variables, and the other - Path analysis - while 'accurate' in that it reflects defined models and accounts for spurious correlations, is unable to cope with a large number of variables.

Other techniques are available, but all are known to have serious deficiencies. Included amongst these are analysis of covariance (non-random allocation to groups), partial correlation (partialling out environmental effects), stochastic methods (Richards, 1966), (change rather than output oriented) and actuarial techniques (large samples needed).

Errors of measurement can play a significant role in distorting statistical evidence. The most notable effects arise from the alteration of the correlations of variables with large measurement errors:

> An even subtler and potentially more serious consequence of measurement error -- one that arises not only in matching designs but also in designs that use correlational methods -- in attenuation in the observed correlation between input and output variables. It is a well-known statistical fact that error of measurement in either of a pair of correlated variables lowers their observed correlation. To the extent that such attenuation results from error in the input variables, a serious bias is introduced into the analysis if the input variable also is correlated with environmental variables. (Astin, 1970a, P.244).

Such an event is likely to lead to a type I error (rejection of the null hypothesis when it is true).

These analytical models and designs reflect the behavioural approach that the behavioural outcomes (learning) can be related mathematically by some linear function of input variables (background and environmental) without reference to unobservable mediating variables. (In contrast. Path analysis can include mediating variables through a form of factor analysis). Moving from the domain of observable variables to inferred variables requires more definitive models, such as described in Section I. This then is the current state of the art - doubts and confusion over research design, and analytical techniques,

2.3. Environmental Measures

One may categorize environmental measures in a number of ways. For example Astin (1970b) describes Image measures (such as CCI and CUES) student characteristic measures (such as EAT), stimuli measures (ICA) or measures based on structural and organisational characteristics. Centra (1972) used three classes - perceptual, objective, and activity self-report in his study of college environment assessment techniques.

The two major elements that appear to effect the meaningfulness of the measures, however, are the way the information is obtained (subjectively or objectively) and treated (individual or bulk). Table 2.1 illustrates the position of a number of well known environmental assessment methods on these dimensions.

Table 2.1

A Classification of Environmental Measures

		Objective		Subjective
Bulk	EAT	Astin (1961), Astin and Holland (1961, Astin (1963), Micheal and Boyer (1965), Panos and Astin (1968), Creager and Astin (1968), Pervin (1968), Richards (1970)	CCI	Pace and Stern (1958), Micheal and Boyer (1965, Stern (1970)
			CUES	Pace and Stern (1958), Marks (1968)
	ICA	Astin (1968), Previn (1968)	TAPE	Pervin (1967), Pervin (1968)
	Also	Olson (1966) Thistlethwaite and Wheeler (1966) Richards, Seligman and Jones (1970)	Also	Clark and Trow (1966)
Individual				Bushnell (1962) Riseman and Jenks (1962) Lewis (1969), Pervin (1967)

Let us consider the problems related to each dimension of environmental measurement.

Bulk - Individual

Bulk measures can be developed in two ways - measures that are determined from demographic or institutional variables (such as religious affiliation, sex ratio, areas of emphasis, resources, size) or from the aggregation or consensus of students on measures derived from questionnaires. Both tehcniques assume that there exists one environment for all students - a common element in their academic lives, or that by summing perceptions one derives a measure of common environment which is the most valid measure('reality is shared perception'), or at least, the most important measure. (See, for example, Becker, 1966, quoted in Feldman and Newcomb, 1969, p. 229).

The bulk approach falls foul of the fact that 'environment' is an individual experience. As Feldman (1970) states:

> ..... the'assumption that the aggregate awareness of students about their college environment constitutes a press in the sense of exerting a directive influence on their behaviour' ... may not always be a good one. It is not really clear to what extent the features and characteristics of the environment, as garnered by the use of the CCI or CUES, represent either social or normative pressures on students.
>
> (Feldman, 1970, p.13).

Feldman notes other problems of major significance, namely:

(1) The bulk measures are extremely sensitive to sampling errors, or to extreme group opinions.

(2) The measures commonly seek individual opinions about the group for subsequent aggreation, and this approach is susceptible to 'rumours, engaging in wish fulfilment or stereotyping'. (p.13).

And, in addition two further comments:

> The interpretation of scores on CCI and CUES is somewhat ambiguous because the scores reflect amount of consensus in the environment as well as intensity of environmental emphasis (Selvin & Hagstrom, 1963). Moreover, scoring procedures do not take into account the possibility that students may vary in knowlegeability about various aspects of the environment, a fact which may mean that scores should be differentially weighed.
>
> (Feldman, 1970, 13).

Other critics of bulk measures include Marks (1970) and Richards (1974).

Quite clearly, bulk methods fall far short of providing meaningful measures of environments.

This sort of conclusion suggests that attempts to study inter-institutional environmental impact will inevitably fail. There is further ground for this pessimistic conclusion, provided by Astin (1970), notably that institutions have self-selective properties that result in non-random allocation of students. It is impossible, in such studies, to control input variables in a way that would enable the impact of bulk environmental variables (should they exist) to be measured.

Group measures provide greater opportunity to deal with real environments - but the expected approach of analysing interacting sub-cultures seems to be ignored. Instead one finds demographic, and administrative variables utilised again Olson (1966), Thistlethwaite & Wheeler (1966) or 'sub-cultures' defined by common interests and attitudes - but not by mutual interaction (Clark & Trow 1966). For this reason, we are no closer to real measures of environment, but are left with the somewhat dubious bulk measures on a smaller scale.

Individual measures reflect the philosophy that the interactive environment is the product of reality and perception - a philosophy espoused by Murray (1938), clarified by Rogers (1965) and quantified in Lewin's familiar expression $B = f(P,E)$ (Behaviour is a function of Personality & Environment). This expression suggests to us that if we are to study the impact of environments (exposed to us through behaviour), we must control all aspects of personality. In other words, the largest unit we can take is the individual.

It is not hard to understand why this approach has rarely been explored elsewhere - the problems involved in a study at individual level by standard techniques are insurmountable. One is frequently obliged to focus attention on case studies (Bushnell, and Riseman and Jenks - in Sanford 1967) that make generalizations across the wider group difficult.

Given adequate analytical techniques, individual measures of environment that retain their individuality are the only meaningful and valid measures.

Objective-Subjective

It has already been implied that it is the intensely personal perception of environment that is the main agent for impact in education. It follows from this that subjective measures are the most meaningful - for they already have been modified by personality.

The significance of this characteristic is borne out by Feldman and Newcomb's seventh conclusion:

> 7. In addition to the effects of campus-wide influences and the pressures of subenvironments, college impacts are conditioned by the background and personality of the student. (Feldman and Newcomb, 1969, p.3).

Marks (1968) warns that responses to CUES and CCI may reflect personality as much as the 'real' environment.

Environmental measures must therefore accept and, indeed depend on idiosyncratic perception.

Rogers'proposition II in 'Client Centred Therapy' states:

> The organism reads to the field as it is experienced and perceived. This perceptual field is, for the individual, 'reality'. (Rogers, 1965, p.484).

In these terms, it can be seen that so called 'objective' measures are really the investigator's subjective perceptions. They are not necessarily the reality to which individuals respond. Valid and meaningful measures of environment must therefore be subjective. Subjectivity need not be viewed as a weakness of measurement, but as an important indicator in itself.

The potential reliability and validity of such measures is attested to by Costin, Greenough and Menges (1971), and by Pervin (1968).

One of the strongest opponents of perceptual and self-report measures is Astin (1970b, p.440).

> A major difficulty presented by the image approach to measuring environmental characteristics is that the student's perception of his college can be influenced not only by what the college really is like but also by how it has influenced him. Thus, if a particular image factor is found to 'affect' some student outcome, we can not be sure that we have explained the observed effect adequately simply because the student's perceptions may have been influenced by the effect itself.

Hall and Lindzey (1957) are also critical of self-report techniques

Weighing these criticisms, one must come down on the side of perceptual measures, for as Rogers observes (Proposition VII)

> The best vantage point for understanding behaviour is from the internal frame of reference of the individual himself.
> (Rogers, 1965, p.494).

Meaningful measures of environment must be individual/subjective. The closer one moves towards this ideal, the more likely one is to arrive at a valid understanding of the complex person-environment and person-person interactions.

2.4. Measurement of Achievement

Astin (1970a) expresses concern for the lack of attention to achievement as an output variable in impact research. This lack of attention is inevitable so long as one deals with inter-institutional comparisons, because one is forced to aggregate results (that have probably been manipulated to fit set distribution requirements) from a wide range of measures, possessing varying degrees of validity. To overcome this problem one must either:

(1) develop tests which can be administered uniformly across institutions (see for example, Halstead, 1970); or

(2) work at a level where the validity of a test is an acceptable and necessary characteristic of the criterion variable i.e. at the individual lecturer/student level.

The first alternative is unacceptable because it pre-supposes uniform goals across institutions, and meaningful acceptable definitions of academic achievement. Neither requirement can be met.

The second alternative has already been suggested through the Models of Smith (1960) and Runkel (1958) discussed earlier. What is being suggested here is that a lecturer's rating of a student - with all its in-built invalidity is the criterion of importance. With this approach in mind, invalidity no longer is important, but of course, unreliability is. (i.e. we want consistent invalidity!). One can break down a student's score as follows:

1	11	111	1V
Student's true ability	Staff member's general invalidity	Staff/Student interaction component	Unreliability

Figure 2.10

Components of Variation in Test Scores

One can control for II by standardisation within classes, for I by repeated single sample experiments. III represents the component due to interactive effects in learning and testing - the criterion of importance in this study. IV represents the undesirable portion that must be kept to a minimum.

There are no examples of previous research available that take this line of reasoning or similar, so none can be reported.

2.5. Studies of Interaction

A number of writers have conducted or reported studies similar in style to the one proposed in this thesis. While generally different in origin and form, they support the line of research.

Baird, in an extensive study of teacher and student behaviour, calls for a study on 'the interaction between student characteristics and the influence of the [teaching] styles...' (1971, p.13). McKeachie (1961) states (p.112):

> The practical problems of predicting academic achievement and identifying effective teaching methods are not alone in pointing to the importance of studying interactions between student characteristics and teaching methods. There are also good theoretical reasons for looking at such interactions.

Pervin (1967) shows that self-college similarity (on his TAPE measures) is related to student satisfaction, Pervin and Rubin (1967b) show a relationship between person and environment on the same measures and 'drop out' rates.

Attending more directly to achievement as the criterion, Centra and Rock (1971) show amongst other findings, that achievement is related to quality of student-faculty interaction. Cohen and Berger (1970) identify student-faculty interaction, student interest, and course organisation as significantly related to student achievement. Lavin, in his review of research into the prediction of academic achievement (1965) concludes that:

> First, the degree of congruence in student-teacher values, attitudes, and expectations is directly related to the academic performance of the student. Furthermore, this generalization holds even when the student-teacher similarity involves what seem to be task-irrelevant criteria. (p.144).

and also

> Research on the student-teacher relationship suggests two generalizations. First, the more the student's attitudes and values coincide with those of the teacher, the higher the student's academic performance will be. Second, characteristics of teacher behavior may affect the performance level of the student. (p.150).

Lavin also concludes:

> The findings showing that congruence in student-teacher values, attitudes and role expectations is related to academic performance raise the question of the casual direction of such relationships. The degree of congruency could be either a determinant or a result of the level of academic performance - or there might be a feedback relationship between the two. With feedback, a moderate degree of congruency might result in a fairly high level of performance as indexed by the teacher's grades, and this, in turn, might serve to increase the student's identification with the teacher's values and attitudes, thus leading to an even higher subsequent level of academic performance. This question requires further work addressed to the assessment of time sequence in the operation of these variables. Furthermore, if student-teacher congruence is a causal factor determining grades, differential student awareness of teacher definitions of the student role may be a result of differences in social sensitivity. If so, the research in social perception would become relevant to the study of academic performance.
>
> (Lavin, 1965, p.144).

This raises the important issues of feedback, and suggests that studies which concentrate on too narrow a criterion may not be getting at the real cause. The chapter that follows deals with these issues at some length.

2.6. Conclusions

Four major problems, which in effect invalidate all previous research into the impact of student/teacher interaction were identified. Previous research on these problems has been discussed, leading to four main conclusions:

(1) A useful and meaningful theoretical framework must be used to enable achievement to be related to interaction type variables.

(2) Research models must eliminate the problems of matching and non-random allocations. Statistical techniques cannot accommodate these problems.

(3) Intellectual environment must be measured in a phenomenological way, and the record of such a measure must not be lost in aggregative techniques; and

(4) Achievement must be defined in such a way that the characteristic invalidity of individual marks is allowed for as an inseparable, necessary component.

Overriding these considerations is the requirement that the research must be conducted in a natural setting, with minimum disturbance from the researcher. The techniques described in the chapter that follows must meet this goal.

> In addition to the arguments from the levels of practical necessity and theoretical exigency, an intermediate level of argument may be adduced. I would argue in extension of Cronbach's thesis that even though education research needs both more basic research and more applied research, its greatest present need is for research which tests out theoretical concepts and relationships in a naturalistic setting. If we attempt to apply any current behavior theory to education, we find that the gap between theory and educational practice is so great that educators can draw no clear implications from behavior theory. This is not the fault of the behavior theorist. He is quite right, I think, in studying whatever interests him,working in relatively simple, pure situations. (See Spence, 1959). Even in these situations, the task of developing comprehensive theories and establishing quantitative laws is difficult enough to absorb all of the energy and talen available. To ask the behavior theorist to work out the applications of his theories is simply to draw him away from his central task. Nevertheless we do need researchers who with understanding of behavior theory undertake research in complex natural situations.
>
> (Astin, 1970a, p.112).

CHAPTER 3

THEORETICAL FRAMEWORK AND RESEARCH METHODOLOGY

A general conclusion of Chapter 1 was that the studies of interaction and communication theory held great potential for furthering understanding of variation in achievement. A tentative hypothesis was framed relating teacher-student congruence to student achievement. The function of this chapter is to introduce a research-study designed to test such a hypothesis. In introducing this study, this chapter will enlarge on a particular theoretical framework which enables a formal hypothesis to be framed, and will define the research environment which will enable such a hypothesis to be tested.

3.1. Theoretical Framework

Chapter 2 reviewed a number of theoretical frameworks relating to interaction, in an attempt to identify one that could be used or adapted to meet the following two requirements:

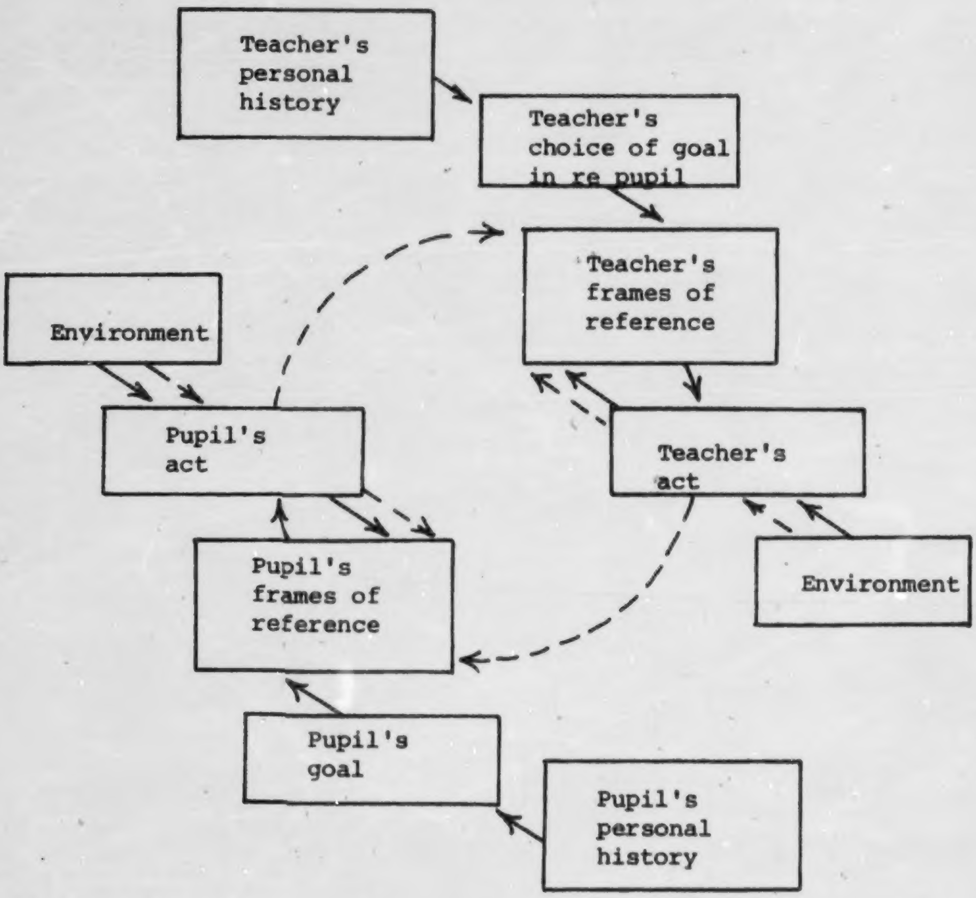
(a) Describe the interaction situation in a manner that enables effectiveness of communication to be related to measurable independent variables.

(b) Enables the criterion variable (achievement) to be related to the independent variables.

3.1.1. Runkel's Paradigm of Interaction

The model proposed by Runkel, described by Gage (1963) serves such a purpose. As it was last discussed in Chapter 2, some reiteration and expansion is required.

Runkel's paradigm, illustrated again in Figure 3.1, has five main features:


Teacher's personal history
Teacher's choice of goal in re pupil
Teacher's frames of reference
Environment
Pupil's act
Teacher's act
Environment
Pupil's frames of reference
Pupil's goal
Pupil's personal history

Solid lines represent intrapersonal communication via the nervous system, etc. Dashed lines represent interpersonal communication via vision, speech, etc.

Figure 3.1.

Runkel's Paradigm
(From Gage, 1963, p.126)

(a) It is cyclic in nature, illustrating the ongoing nature of communication. The loops represent messages sent either as feedback, or initial stimulus. The teacher's or pupil's act may be verbal or non-verbal, deliberate or unconscious.

(b) The model recognises that messages are interpreted by the receiver. Response to a message or behaviour is not simply a function of that behaviour, but of one's perception of it. This perceptual frame of reference or perceptual filter provides consistency and uniqueness to one's behaviour that either is itself, or a sign of, personality.

Not only does one interpret and evaluate the actions of others in the light of one's frame of reference, but likewise one evaluates one's own behaviour, hence the closed feedback loops linking 'act' with 'frame of reference'.

(c) The frame of reference or perceptual filter reflects one's goals. Personality as a whole reflects life goals (cf. the work of Adler); intellectual style as a perceptual filter reflects educational and intellectual goals (hence the development of the SGO scale in Chapter 4) or educational and intellectual roles (hence the SRO scale also in Chapter 4).

(d) These goals are of themselves a produce of the individual's personal history.

(e) The whole interaction process is imbedded in an environment which directly acts to constrain the range of behaviours of the participants.

Runkel's model is well founded on psychological premises of others. One can find support for the five features described in a number of significant writers. To cite a few:

The perceptual filter notion is expressed in Roger's (1965) first three propositions of 'A theory of Personality and Behaviour'.

> I Every individual exists in a continually changing world of experience of which he is the centre. (p.483).
>
> II The organism reacts to the field as it is experienced and perceived. This perceptual field is, for the individual, 'reality'. (p.484).
>
> III The organism reacts as an organised whole to this phenomenal field. (p.486).

The notion of the perceptual filter can also be seen in communication theory. Osgood (1953) describes it in terms of an encoding/decoding function. (See also Chapter 2).

Piaget recognises that the assimilation or accommodation of information depends jointly on environment and intellectual structure.

Stern, Stein and Bloom (1956) stress the importance of understanding the individuals internal structures or internal frame of reference as a prerequisite to understanding behaviour. (p.46).

It is not unusual, then to find the notion of perceptual filter common to a wide range of theorists.

The origins of this frame of reference are less obvious. Rogers, in propositions IX and X expresses clearly that the origins are in 'interaction with the environment, and .... evaluational interaction with others ......' (p.498).

Piaget also indicates that the intellectual structure is changed in the accommodation process, so developing the perceptual framework. Of course, these perceptions are distorted, if possible, to fit existing structures. In proposition XI Rogers states that the individual has three options (i) to accept the experience as it is; (ii) to ignore the experience if it does not fit the self-structure; or (iii) to distort the experience to make it fit. (p.503).

There must be more fundamental origins, and Rogers suggests these in propositions IV and V:

> IV The organism has one basic tendence and striving - to actualize, maintain, and enhance the experiencing organism. (p.487).
>
> V Behaviour is basically the goal-directed attempt of the organism to satisfy its needs as experienced, in the field as perceived. (p.491).

Hence, the origins of perception lie in basic needs and goals. Needs and goals are not of themselves unchangeable, however, the changes that do occur are ordered by a relatively stable construct personality (Marks 1968, 1970).

Behaviour is consistent with perception (Proposition II) and the frame of reference. Proposition XII states:

> Most of the ways of behaving which are adopted by the organism are those which are consistent with the concept of self.
> (Rogers, 1963, p.507.)

In an educational setting, the above needs to be reinterpreted in very specific ways. Before this is done, a number of difficulties with the model will be discussed.

(a) The model represents a true didactic interaction situation. The processes represented by the dashed lines between individuals occur in a face to face interaction in an unpredictable and largely immeasurable manner (Verbal and non-verbal). Quite apart from imposing enormous limitations on research into such interactions, it also encourages perceptual changes (Porposition IX). To be of theoretical and experimental use, the model must be expressable and meaningful in a linear (non-cyclic form).

(b) The role of environment as simply an objective inhibitor of action is inconsistent with the concept of perception. The arrows should indicate that the environment is itself perceived, and that the actions of the participants are part of each other's environments.

(c) The model only illustrates one-to-one correspondence between teacher and pupil, which is not the common situation. Nor does it allow for pupil-pupil interaction.

3.1.2. Adaption of Runkel's Paradigm

These criticisms require careful consideration if the model is to generate testable hypotheses.

(a) To develop linear forms of interaction, one must identify learning situations where the cycle is broken, in other words, where the pupils cannot provide feedback. The ideal situation - the television lesson - is not sufficiently common, but the 'traditional' university lecture is. Non-verbal feedback is of course possible, and at times, so is verbal feedback, but in general, the feedback levels are very low indeed in a formal lecture. The selection then, of learning that takes place chiefly in the lecture situation is, subject to the test of the low feedback assumption, the best environment to test the model. This environment also reduces student-student interaction and puts the student-teacher interaction in a form of one-to-one interaction.

The lecture situation can be illustrated by Runkel's model adapted as shown in Figure 3.2.

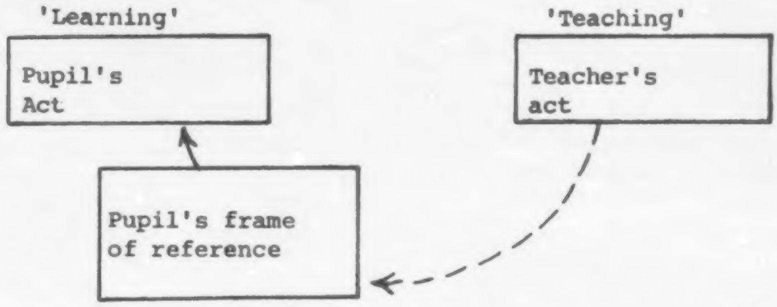


Figure 3.2.

The Lecture Situation

A second assumption arising from the lecture situation is that only one lecturer should take the course of study measured by a criterion measure (examination). This would maximise the relationship between teacher's act (teaching) and pupil's act (learning).

The criterion variable of this study is achievement - as measured by the teacher. Fortunately, the assessment process is also an interaction process of a linear kind, as shown in Figure 3.3.

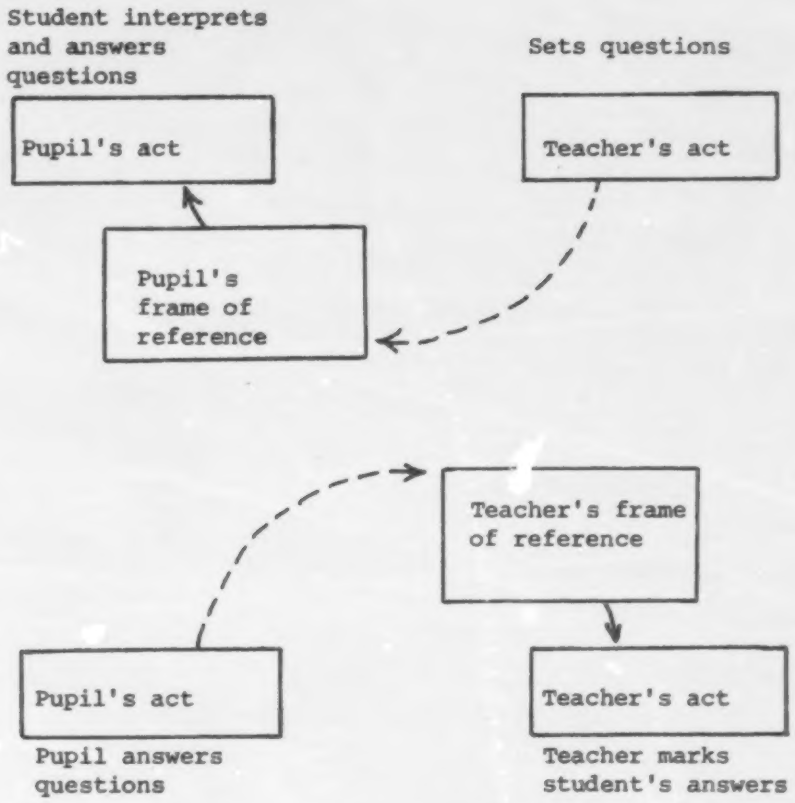

Student interprets and answers questions
Sets questions
Pupil's act
Teacher's act
Pupil's frame of reference
Teacher's frame of reference
Pupil's act
Teacher's act
Pupil answers questions
Teacher marks student's answers

Figure 3.3.

The Assessment Situation

This introduces a third assumption, that the lecturer who taught the course must also set the examination and mark it on his own. This will, in effect, provide an interaction chain of the kind illustrated schematically in Figure 3.4., that will maximise any interaction effects present.

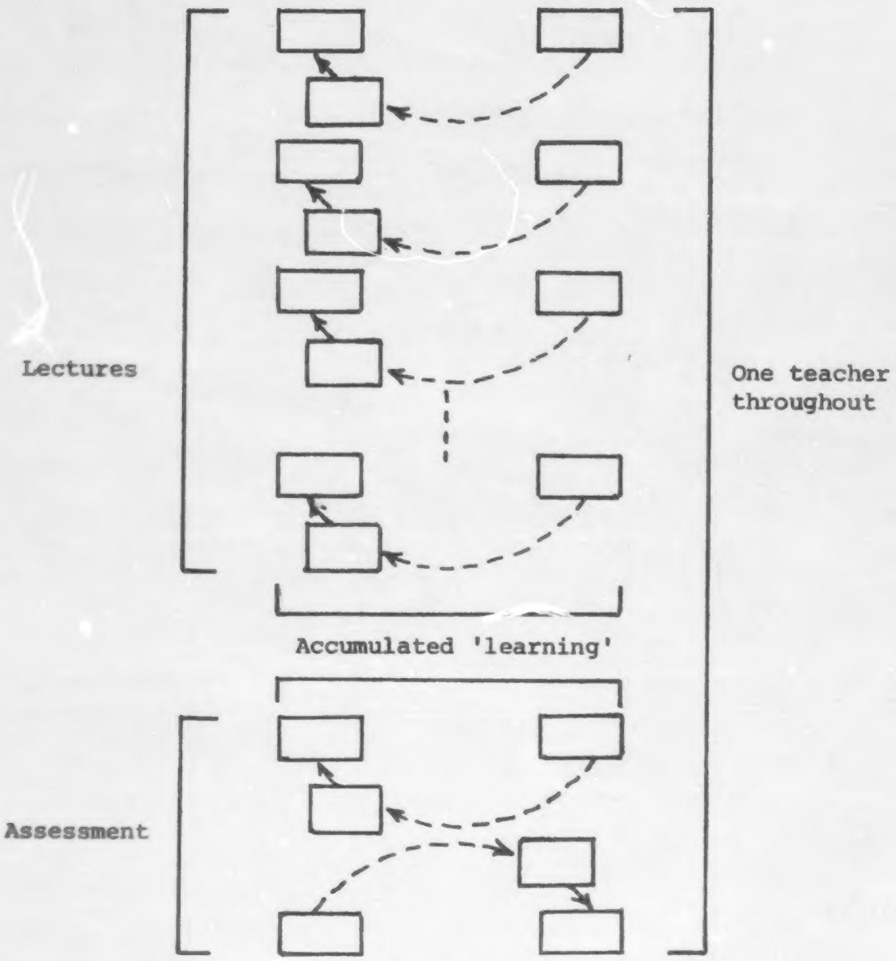

Lectures
One teacher throughout
Accumulated 'learning'
Assessment

Figure 3.4.

The Lecture/Assessment System

This also validates the approach suggested in Chapter 2 of relying on the lecturer's assessment to provide the criterion measures. An additional advantage is that study of the interaction process is in its entirety in a natural setting, with no interference or turbulence caused by the researcher. The generalization of a study conducted in this way tc the 'real' situation is thus assured.

The model, in this linear form also describes the situation in which the independent variables are measured. Such measures are an interaction between the individual (student or lecturer) and the researcher, whose behaviours in acting and assessing are standardized by the closed response questionnaire. This interaction can be illustrated in a similar fashion to those above in Figure 3.5.

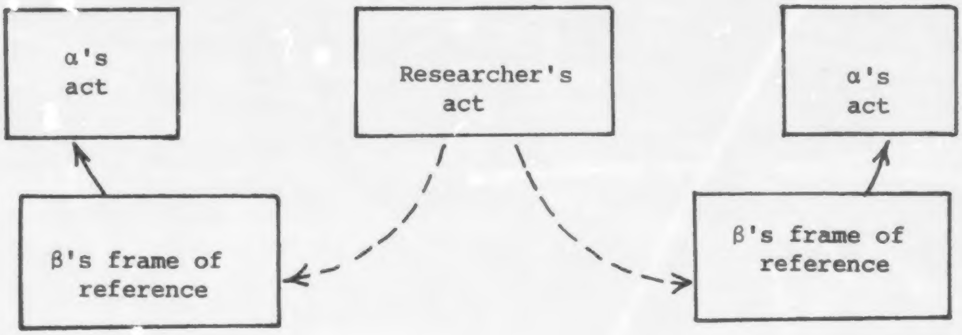


Figure 3.5.

The Researcher/Subject Interaction

Given a single researcher's act (the questionnaire), then the difference between α's frame of reference and β's frame of reference can be inferred from the difference between α's act and β's act. The problem is to ensure that the stimulus (the questionnaire) is in the appropriate domain to evoke reactions indicative of style of intellectual functioning.

3.1.3. An Evaluation of the Revised Paradigm

Deutsch (1952), cited in De Vito (1970) suggests seven criteria by which models or paradigms may be evaluated. A model should:

(a) organise elements and processes. The model described illustrates clearly the dependence of action on perception and the nature of the communication process;

(b) aid the discovery of new hypotheses and new ways of looking at communication;

(c) suggests valid measures of its components;

(d) be simple. Often a model requires greatest description that's the real situation it seeks to describe. Deutsch suggests that increasing simiplicity is accompanied by increasing generality;

(e) be realistic. The model must reflect common understanding of the situation. The close it is to reality, the more chance it has of reflecting complex relationships; and

(f) be original. The model should arrange variables in a manner 'not totally obvious or self-evident'. Otherwise, the model serves no function in extending our concept of the situation.

In terms of these six criteria, the model presented seems to be quite satisfactory. It is on the last criterion that some doubts are cast.

The seventh criterion, is that a model generates predictions. Quite clearly, the framework provided by the adapted Runkel model warns of potential difficulties that must be overcome through sound research design, but it does not itself generate predictions. It is, therefore, more correctly termed a paradigm, which mainly represents a situation diagramatically, without any pretence that it simulates it in any way.

To frame hypotheses, one must look to the supporting theories of the paradigm, in Roger's self theory, Communication Theory and Learning Theory.

3.1.4. The Formulation of Hypotheses

The workface of the teacher/student learning situation and the assessment situation is in communication. Communication involves the encoding of a message, its transmission, its reception, decoding and interpretation. Distortion, resulting in miscommunication, can arise in each process.

(1) In the encoding the lecturer (in the teaching situation) transforms the material to be learnt into a transmittable form (spoken word, written word, action etc.). By 'material to be learnt' one must include not only curriculum material but also the hidden curriculum of attitudes that the lecturer either consciously or unconsciously transmits. The encoding material, and hance the message, will reflect the fundamental style of intellectual functioning of the lecturer, and so will differ from person to person. This variation may be gross, in terms of emphasis, medium used, or choice of content, or very subtle. This is the chief problem of studies that are based on observation only - they cannot allow for the idiosyncracies of encoding, nor the inevitable subtle communication modes.

(2) The message may be distorted in transmission. This is not only a problem of 'noise', but a problem of message/medium interaction. This distortion compounds the distortion described above, but as the medium can be seen to be an extension of the lecturer (he chooses it), then such an affect will merely accentuate the encoding distortion.

Marshall McLuhan describes this distortion in his now famous line 'The Medium is the Message', in the frame of reference of this study; one can paraphrase that to say that the medium tells us something of the emitter.

(3) Receiving and Decoding. The final stage of distortion occurs at the receiving and decoding stage. This results from receiver/medium interaction. The paradigm suggests that this is simply the perceptual frame of reference, or in terms of our emphasis, the style of intellectual functioning. The distortion may have two possible effects: (a) the restoration of the message to its original form (internal to the lecturer); or (b) the further distortion of the message. The quote from De Vito cited earlier and common cypher theory tells us that (a) will occur if the decodes and encodes are complementary; and that (b) will occur otherwise, to a degree dependent on the degree of cypher incompatability. Fulcher and Anderson (1974) express this concept as follows:

> A long-standing principle of human communication has been that source-receiver similarity promotes communication effectiveness. Therefore, as source and receiver converge along attributes which are relevant to the communication situation, the potential effectiveness of communication should increase. (p.19)

Hence, the first step toward a hypothesis is to state a preliminary hypothesis:

PH1 - In a learning or assessment situation; miscommunication will occur between the participants to an extent proportional to the degree of incompatability or difference between their styles of intellectual functioning.

Once the message has reached the teacher it is to be subsumed or 'learnt' in whatever distorted fashion the decoder prescribes. Rogers has described the options open to the learner as - (a) symbolization, perceived and organised (learned), or (b) rejected outright, or (c) distorted to enable (a) to occur. (Proposition XI p.503). Piaget also offers two alternatives - accommodation (learning) or assimilation (distortion or selection to avoid learning).

Learning, then, in the sense of information or attitudes internalised is directly dependent on communication. By the lecturer's conscious or unconscious criteria, miscommunication will result in 'less' learning (or incorrect learning). One is thus able to state a second preliminary hypothesis.

PH2 - The nature of internalised information or attitudes (learning) is directly dependent on the communication process from which it is derived.

Viewing PHI and PH2 together, enables one to state:

PH3 - In a learning situation, 'mislearning' will occur in the student (in terms of the lecturer's internal criteria), to an extent proportional to the degree of incompatability or difference between their styles of intellectual functioning.

Ausubel and Robinson (1970 describe this in terms of internal structure, but also in terms of 'learning set' - the desire to learn 'meaningfully'. Such a 'set' may be itself sensitive to the mode of communication, and hence affect learning, strengthening PH3.

Throughout the course, the student accumulates these 'mislearnings'. Mislearning is built upon mislearning, and upon completion of the course he has reached a point some way distant from his lecturer's intentions, that distance being proportional to their cognitive dissimilarity. This is assuming, of course, that the student does not have the opportunity or the desire to change his learnings from those he *believes* his lecturer has intended (for example, by reviewing books, or by extensive communication with the lecturer, other lecturers or students), nor that he changes in style himself by inculcation of the style of the lecturer, nor that he learns to adapt to different lecturers successfully.

The student approaches the assessment situation with these learnings, and with expectations relating to the style of examination. As the paradigm describes, the lecturer attempts to communicate a requirement to the student through the examination paper. The student interprets with an accuracy proportional to the fit of cognitive styles (PH1) and expresses his mislearnings (also proportional to the fit of cognitive style (PH3) in his answers), further accentuating any distortions.

The *coup de grace* is performed by the lecturer, who for the first time, receives the student's communication, and by a similar argument to the foregoing, arrives at an evaluation of the student's learnings even more distorted than the answers would objectively indicate. The mark awarded by the lecturer constitutes his measure of the student's learning, and represents the measure of that student's achievement in that course. It is, of course, a compound measure, which includes amongst error and 'real' achievement, attitudinal biases. No apology is made for this criterion; it is, after all, the criterion by which students are lost or made - these are the real criteria of success or failure, wastage and quality.

By this reasoning, one can arrive at a series of hypotheses relating achievement to communication effectiveness and person's learnings.

PH4 - In the assessment situation, the student's understanding of the questions will be directly proportional to the degree of similarity of the styles of intellectual functioning of that students and the examiner.

PH5 - In the assessment situation, the student's responses will be a function of his previous learnings and his understandings of the question.

PH6 - In the assessment situation, the examiner's assessment of a student's responses will be a function of those responses, the examiner's expectations, and the degree of similarity of their styles of intellectual functioning.

Considering PH6 with PH5 (student's responses) and PH4 (student's understanding) and PH3 (student's learnings) enables the major and final hypothesis to be stated:

HI - The achievement of a student as determined by a lecturer/examiner, will be a function of their similarity in style of intellectual functioning.

More precisely, one can state:

H2 - Holding other variables constant, the greater the degree of similarity in style of intellectual functioning between student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

or as a Null hypothesis:

HO - Holding other variables constant, there is no relationship between similarity in style of intellectual functioning between student and lecturer and that student's achievement as measured by that lecturer.

3.2. Research Methodology

The task now is to devise a means to test this hypothesis. Certain constraints have already been laid down by the theoretical framework and in the derivation of the hypothesis. Further constraints will be imposed by statistical and research requirements. It is the function of this section to define rigorously these conditions.

3.2.1. Environmental Requirements

The following six requirements originate from the specific use of Runkel's model in linear form:

(a) Limited or no student-staff feedback during the actual teaching, and during the course as a whole;

(b) limited student-student communication on issues relating to style of intellectual functioning;

(c) little or no change in the student or staff orientation over a complete semester;

(d) one teacher (who is also the examiner) for each course or part of course with an identifiable achievement measure;

(e) comparable situations between courses (similar learning environments);

(f) highly reliable assessment techniques.

Requirements (a), (b), (d) and (e) suggest the lecture situation at tertiary level. Studies conducted at tertiary level suggest that there is very little contact outside the lecture theatre, and observation and experience show there is very little encouragement or opportunity for staff-student interaction in the traditional lecture environment. Feldman and Newcomb sum the situation as follows:

> ....With the exception of certain smaller schools, students in general do not indicate very much or very close contact with faculty outside the classroom. Between one-third and two-thirds of the students, depending on the college, say that their contact with faculty is quite infrequent. Also, large minorities or even majorities of students at various schools describe a failry depersonalized environment in which they see their teachers as not especially concerned with their personal welfare.
>
> (Feldman and Newcomb, 1969, p.249).

It is widely accepted that a significant problem with the exclusive use of the lecture approach is difficult with feedback. This is stressed by such writers as Beard (1970), Bligh (L972), and by the report of the A.V.C.C. (1965). McKeachie (1965) describes the lecture situation thus:

> Since student typically have few opportunities to make responses during lectures, they seldom receive feedback from their efforts to learn during lectures. Delay of feedback may not, however, seriously hinder the learner in acquiring knowledge if he is motivated and the material is not too difficult. We would expect lack of feedback to be a greater handicap if the lecturer's goal is to develop concepts or problem-solving skills. There is experimental evidence that when this is the goal, active participation on the part of the learner is more effective than passive listening or observing. (p.1126).

Requirement (a) can thus be easily fulfilled by the selection of the traditional lecture environment.

Assumption (b) is more of a problem. There is quite obviously a good deal of student-student interaction outside the lecture theatre. The model requires little communication in the learning situation, and the physical design of the lecture theatre, and the style of teaching limits this. The interaction outside the theatre is only a problem if it could result in change in style (requirement (c)), or if the contact enables a student to correct mislearnings. The former can be tested, the latter is immeasurable and will have to be regarded as an impurity in the design that hopefully will not obscure the sought effects.

Chickering (1959) reports low incidence of feedback outside class:

> We found that at all the colleges except Kildew 90-95% of the students spend one half hour or less talking about formal academic assignments, future educational and vocational plans, or problems of personal concern. Forty to sixty percent spend no time at all talking about such topics with members of the faculty and administration. (p.2.).

and again

> Point number one therefore - limited communication outside of class! Limited in the range of different faculty members seen, limited in the numbers of conversations, limited in the amount of time spent -- even on academic and educational planning, matters central to the purpose of the institution and to the prime function of the faculty. And remember, these are not large universities where publication and consultation are emphasised. They are small colleges, presumably devoted to teaching and to student development. (p.3.)

Requirement (d) can be objectively arranged by the selection of a course of study of discreet elements each taught and assessed by one individual.

Requirement (e) can be checked by the observation of lectures, the patterns of room and time allocations and other general considerations.

Requirement (c) cannot be assumed to be true, and must be tested. A statistical technique for such a test is described later in this chapter. Stability is required so that it can be argued that the process extends over some period of time. It also serves a statistical function - if it can be shown that a particular orientation has been held in two semesters, then the results (achievement) of the first semester can be considered with those of the second semester for the testing of the hypothesis, increasing the sensitivity of the test.

Requirement (f) - high test reliability, suggests that the study should be conducted in a field where high test reliability is commonplace. The physical sciences (Physics and Chemistry) are most likely to provide such a testing environment, whereas the humanities the least likely.

The Selected Environment

In view of the above, and partially reflecting the researcher's own background (a Physics graduate), the environment selected as a Physics department at a University. Requirement (d) can be shown objectively to hold, and subjective evidence indicates that requirements (a), (b), (e) and (f) hold. The students undertake three years of study in two possible streams (major, minor) hence, given that statistical requirements are met, there are six potential replications of the study, at three levels.

3.2.2. Statistical Requirements

The major requirement - control of background variables, cited as a crucial factor in this type of research (Chapter 2) - requires two developments - careful experimental design, and selection of statistical techniques.

Chapter 2, section 2 (Statistical and Research Models) describes and evaluates a number of approaches to testing hypotheses of a similar (but not identical) form to the one to be tested here. The discussion reached the conclusion that studies based on matched-group designs cannot possibly match groups on all relevant criteria. Random selection may introduce biases as students do not randomly assign themselves to environments.

In Chapter 2, a simple model for impact studies was described (Astin 1970a). It is shown again in Figure 3.6.

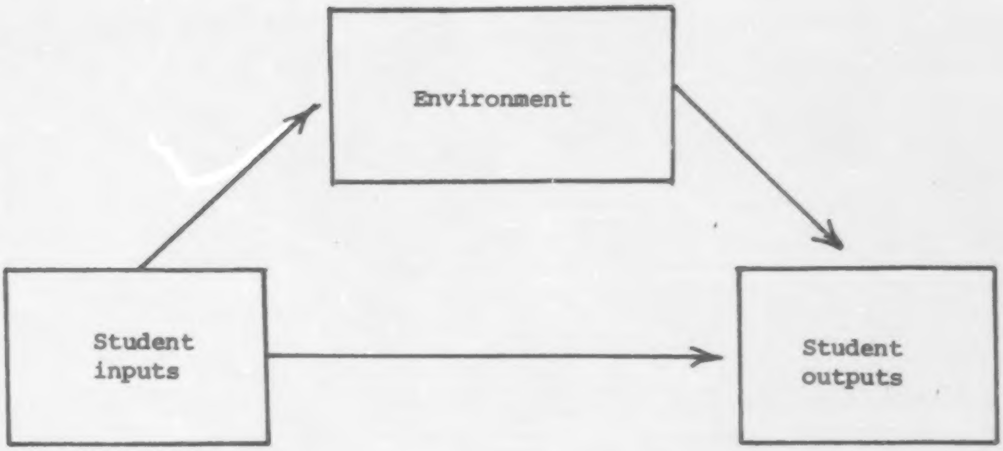


Figure 3.6.

Astin's Model for Input Studies

If one is to accept that, as Rogers asserts, the phenomenological field of the individual is the important measure of environment, then there will be as many different environments as there are observers. Further, if there are many identifiable sub-environments (created by different lectures, for example), then this will further multiply the number of perceptual environments. One can thus redesign Astin's model as shown in Figure 3.7., to illustrate this.

There are, in fact mxn environments described which seems to make the model far more complex. The simplification follows from two observations:

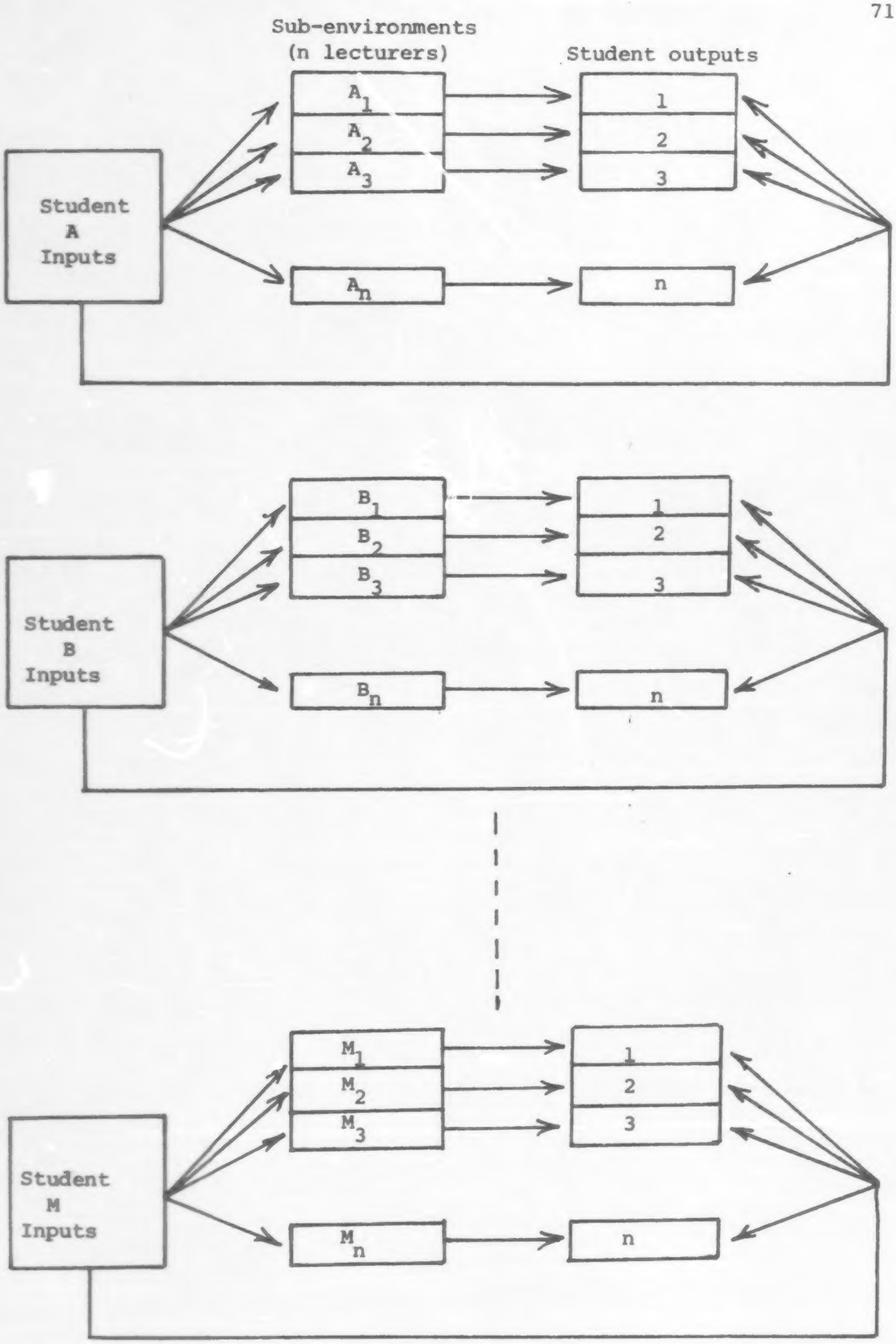

Sub-environments
(n lecturers)
Student outputs
Student
A
Inputs
A1
A2
A3
An
1
2
3
n
Student
B
Inputs
B1
B2
B3
Bn
1
2
3
n
Student
M
Inputs
M1
M2
M3
Mn
1
2
3
n

Figure 3.7

Redesigned Astin Model

(a) Each student represents an experiment in himself, with n treatments and n outcomes; and

(b) this hypothesis simply relates the n outcomes of each student with n measures of staff student similarity. Environments do not have to be specified, they are understood to be a function of student characteristics and lecturer characteristics.

There is a significant advantage in (a). As the student represents an experiment (of which there are M replications) then the problem of the control of background variables vanishes. All background variables relevant and irrelevant are controlled. (Astin, 1970a., p.233).

The use of repeated treatments is not new, although it is usually found in time series design where one treatment follows another. In this study, the treatments occur simultaneously, as do the criterion measures.

The hypothesis refers to a relationship between staff/student similarity and achievement. Assume for the moment that these measures exist. How could such a relationship be detected in view of the type of design described above?

For each student one would have a set of similarity measures (as many as there are different lectures) and a corresponding set of criterion scores obtained from these lecturers. These criteria will be standardized scores (to eliminate lecturer difference in standard deviation and mean) from an examination paper set and marked by each of those lecturers. One could correlate similarity with score for each student, deriving a set of correlations and probability measures of the probabilities?).

An alternative can be found in the test of ordered hypotheses developed by Page (1963). Page describes the problem in his introductory passage as follows:

> For hypotheses involving only two treatments, the one-tailed t-test has long held accepted status. An experiment's reasonable prediction of the order of treatment effects, and his willingness to state his hypothesis in terms of such order, is permitted, when the null hypothesis is false, to make his test more powerful. When he adds another treatment group to the experimental situation, however, he faces an odd discontinuity. With three treatments or more, he has no longer any clear and explicit 'one sided' test in common practice. In the literature he usually considers an alternative hypothesis not adjusted for any a priori prediction of the order of experimental results. Thus, when the null hypothesis is false, he finds statistical significance much more difficult to achieve.
> (p.216).

Page's statistic, known as Page's L, enables an ordered hypothesis to be tested in such a situation. His unusually simple computation belies real strength and versatility.

If it were hypothesised in this experiment that some teachers were better than others for all students, one could apply Page's L quite directly. One would construct a table of the kind shown below. (Table 3.1.).

Table 3.1.

Page's L Test

	n Teachers in hypothesised rank order				
	B 1	C 2	D 3.........	n n	Y_j j=1,n
1	X_{11}	X_{12}	X_{13}	X_{1n}	
2	X_{21}	X_{22}	X_{23}	X_{2n}	
3	X_{31}	X_{32}	X_{33}	X_{3n}	
4	X_{41}	X_{42}	X_{43}	X_{4n}	
	'	'	'	'	
	'	'	'	'	
	'	'	'	'	
m	X_{m1}	X_{m2}	X_{m3}	X_{mn}	

The X_{ij} represents the rank of a student (either student i or in group i) with teacher j.

In Page's original design the students could either be m individuals each experiencing the n treatments, or, more commonly, mxn individuals allocated to matched sets of n to make up m replications.

Page's L is calculated by determining column sums ($\sum^{m} X_{ij}$), multiplying these by the hypothesised rank for each column (Y_j) and summing products across columns. Hence

$$L = \sum^{n} (Y_j \sum^{m} X_{ij})$$

The hypothesis to be tested does not suggest that there is a 'best' teacher for all students, but that 'best' is relative to the student. There exists, therefore, not one set of hypothesised ranks, but potentially as many different rank orders as there are students (but no more than n!, of course).

Fortunately, the expression for Page's L can be re-written by simple mathematics as

$$L = \sum^{m} \left(\sum^{n} X_j Y_{ij} \right)$$

where Y_{ij} represents the rank of lecturer j with student i. Thus, for each of the m students, a partial L can be calculated $(\sum^{n} X_{ij} Y_{ij})$ and added over the whole group to produce L - a statistic that can be tested.

Page provides a detailed description of the relationship between L and other, more traditional, tests, such as the Fredman X^2. He also relates it to product-moment correlation, and to an average correlation developed by Lyerly (1952). Page reports that Lyerly had also determined the distribution of his average rho, and shows it to be similar to that of L.

Page provides tables for critical values of L for m in the range 3 to 10 and n from 2 to 50, at three levels of significance = 0.05, 0.01 and 0.001. Some of these are derived from exact distributions, others from a normal-deviate approximation.

$$L \text{ critical} = \frac{m(n^3 - n)}{12} \left[\frac{Z \text{ critical}}{m(n-1)} + \frac{3(n+1)}{n-1} \right]$$

where Z is a one-tailed critical ratio for a given probability level. For m larger than 10, or n larger than 50, Page provides a formula for calculating a X^2 statistic

$$X^2_L = \frac{[12L - 3mn\ (n + 1)^2\ ]^2}{mn^2 (n^2 -1)\ (n+1)}$$

which is distributed as chi-square with ldf. As a one-sided test is desired, the probability of the derived X^2 should be halved.

In his concluding remarks, Page discusses the power of the test, and reports that the L test shows itself to be 'remarkably more powerful' than the Freidman X^2 test, which itself differs very little from parametric analogues. Page cites five critera by which the test can also be judged to have considerable utility:

1) computational ease;
2) allows the combination of heterogeneous criteria into a single test of significance;
3) avoids distribution assumptions of analysis of variance;
4) avoids the assumption of equal distances between treatments;
5) incorporates logically derived hypothetical ordering.

The statistic is not without its difficulties however. Bradley (1968) states that 'it is hard to visualize in experimental terms exactly what the rejection region consists of'. (p.137).

Page's L also makes some demands on research design. Firstly, all students in the group of m must experience all n treatments.

Secondly, there must be no carryover effect between treatments. Bradley points out that although this assumption is rarely met, the effects can be reduced by counterbalanced designs. As this experiment does not incorporate a time series design, such a problem would not arise, and carryover effects would tend to increase the probability of a type II error. (Incorrectly accepting the null-hypothesis).

Thirdly, the hypothesised ranks must be determined from 'solid prior reasoning, upon empirical evidence from related experiments, upon expert opinion, or upon other considerations at least as persuasive as justifying the use of a one-tailed t-test'. (Page, 1963, p.219).

Page's L test, then, is an eminently suitable statistical test of the hypothesis. One can now state the hypothesis (H2) in statistical terms.

HS2 Given student achievement rankings Xij for student i with lecturer j, and lecturer/student similarity rankings Yij, in any group where all m students have a common set of n courses, then the statistic $L = \sum^{m} (\sum^{n} Xij)$ will be significant at least at the 0.05 level, determined from the expression

$$L\ critical = \frac{m(n^3 - n)}{12} \left[\frac{Z\ critical}{\sqrt{m(n - 1)}} + \frac{3(n + 1)}{n - 1} \right]$$

A similar null hypothesis could be stated, hypothesising an insignificant ($\rho>.05$) value of L.

The hypotheses discuss lecturer/student similarity. In the next section, the parameters of the intellectual measures to be designed in Chapter 4 and tested in Chapter 5 will be discussed. The remainder of this section will deal with the measure of similarity.

Measures of similarity are readily available in a number of forms. Given a set of characteristics, one can compare individual profiles by correlation or spacial distance, the latter being based on the concept of the n measures represented in n dimensional space. Profiles have three major properties to consider - shape, elevation and accent. Differences in shape are obvious, differences in elevation and accent are shown in Figure 3.8.

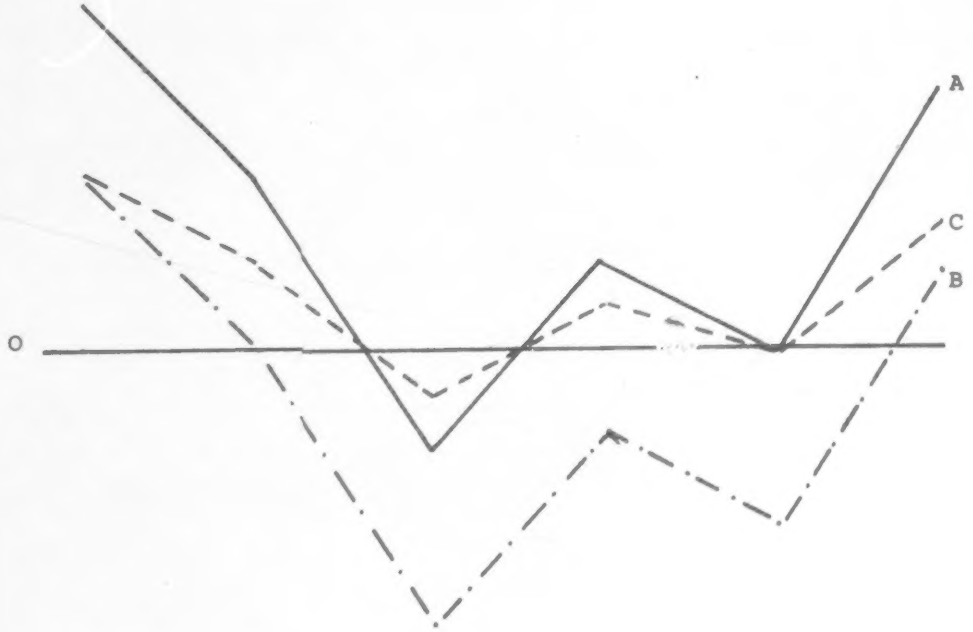


Figure 3.8.

Profile Differences

Profiles A and B differ only in elevation, B and C in accent. Correlation coefficients do not distinguish between these and all three profiles would be regarded the same. Spacial distance measures do make these distinctions and can also correct for non-orthogonality of profile elements.

The simplest form is the measure $D = \sum^{n} d^{2}$, but this produces a measure that is related to scale dimensions and does not consider the effect of finite scales. Cattell (1949) developed a measure r_p that fulfils these needs. r_p is defined as follows:

$$r_p = \frac{E_k - \Sigma d^2}{E_k + \Sigma d^2}$$

where k is the number of profile elements, d are the differences on standardised scales, and E_k is twice the median X^2 value k degrees of freedom. It is a statistic ranging from +1 to -1, hence relfecting a similar range of values to correlation, is not scale sensitive and corrects for change closeness, arising from finite scales, and the number of dimensions or profile factors.

Cattell's r_p has been widely used and its properties are well documented. (Cattell, Coulter and Tsujioka, 1966. Horn 1961, Cattell 1969, Catteli and Coulter, 1966). It is not without its critics, however, notably Cronbach and Gleser (1953), who review a number of indices. They regard the index as artificial and limited. Others simply ignore it, as does Robinson (1957) in his review of measures of agreement.

For non-orthogonal profile elements, it can be shown that

$$d^2 = Z^1 R Z$$

where Z is the original vector matrix of differences and R is the correlation matrix among the elements, and that E_k is twice the square of the sum of the latent roots of R. (See Cattell, Coulter and Tsujioka 19 ,p.303).

These expressions can be computed from the raw data (scores on dimensions of styles of intellectual functioning) and r_p calculated for each student/lecturer pair. These indices so obtained can then be ranked for analysis in the Page's L statistic.

3.2.3. Measurement Requirements

Four requirements can be identified for the measurement of the independent variable, style of intellectual functioning.

1. The instruments must measure appropriate facets of intellectual activity.

2. There must be significant overlap between student and lecturer scores on the scales. Some of the confusion that can arise if such is not the case can be seen in this quote from Fulcher and Anderson (1974).

> The teacher perceived as most similar to the average student self-profile was rated most effective. However, since none of the teacher-sources was perceived as very similar to the average student, this research suggests that moderate interpersonal dissimilarity may in fact yield maximum perceived communication effectiveness. (p.19.).

3. The most significant interaction experience, as far as the criterion measure is concerned, will occur in the examination situation. It is important, therefore, to measure as close as possible to the time of the examination.

4. The usual requirements of quality must be met - validity, reliability, efficiency and unreactivity must all be high.

These, and other issues, are dealt with at length in the following two chapters.

3.2.4. Summary

This chapter has developed a theoretical framework, and has examined its implications to research design and analysis, and has developed a major hypothesis to be researched. Statistical and research methodology has been discussed, leading to the selection of a specific research environment and specific analytical techniques.

After the discussion of the development and validation of the measures of style of intellectual functioning, the results of the study putting these designs into effect will be presented.

CHAPTER 4

DEVELOPMENT OF INSTRUMENTS

To this point, the thesis has outlined the problems associated with research into achievement at tertiary level arising from the study of personal variables, and institutional variables, and has suggested (as others have done) that attention should be directed towards the interaction between student and teacher. Chapter 1 concludes with the argument that:

1. Interaction is a total environmental phenomenon; and
2. Intellectual environment is created by and interpreted by individuals in a manner consistent with their style of intellectual functioning or frame of reference.

Chapter 2 has engaged in an analysis of previous research in relation to environmental impact studies, achievement studies, and interaction studies, leading to four major conclusions.

Chapter 3 has provided a theoretical framework for the development of hypotheses, the measurement of independent and dependent variables, and the research designs and conditions necessary to test that hypothesis.

To this point, however, no attempt has been made to precisely define those styles of intellectual functioning likely to influence intellectual environment. This Chapter provides initially such a definition, then proceeds to describe instruments designed to measure them, and concludes with a report of their subsequent trial and refinement.

4.1. Definitions of Styles of Intellectual Functioning

There are restrictive boundary conditions laid down by the previous chapters that must first be reiterated:

(i) the concepts defined must have relevance to intellectual environment and activity;

(ii) the definitions must be of importance to both students and staff if one is to relate the staff member's created environment with the student's perceptions of it.

Pervin (1968) draws one's attention to the need for environmental and individual reasons to overlap.

(iii) the definitions must allow for the subjective, individual frame of reference required by this type of study;

(iv) the definitions must be sufficiently broad to cover all aspects of intellectual functioning.

Feldman and Newcomb direct their attention along similar lines in their view of staff-student interaction.

> There are certain areas of student values and behavior that do not particularly concern the faculty and where faculty values are more or less irrelevant -- sexual and other private matters, for example. We shall therefore restrict our analysis of the compatibility of student and faculty impacts to academic and intellectual matters.
>
> The academic and intellectual values of the faculty culture often embody expectations that students should be amenable to developing and demonstrating such qualities as the following: strong interest in ideas for their own sake; broad (and

> sophisticated) knowledge of the general culture as well as more specialized information of selected disciplines; ability and motivation to be effective citizens; commitment to certain principles of tolerance, rationality, high-mindedness, and the like. In all this, students are usually expected to take seriously the academic demands of their teachers and to regard the curriculum as valuable and their studies of highes importance.
>
> (Feldman and Newcomb, 1969, p.259)

A review of relevant literature reveals that although there are many questionnaires that evoke information about intellectual habits and perceptions, few are based on the intention to identify internal intellective states. They usually are used simply to provide isolated elements of information for subsequent analysis in relation to a range of criteria. (For example, see the recent study by Cunningham ,1975)

One may view the intellectual environment chiefly from the student's position, in which case one is concerned with student goals, or, alternatively, from the lecturer's viewpoint focusing on staff roles. The remainder of this section deals with these two approaches to intellectual functioning, described from here on as the Student Goal Orientation (SGO), and the Staff Role Orientation (SRO).

4.1.1. Student Goal Orientation

A promising representation of a simple but comprehensive definition of intellectual style or state can be found in the work of Trow(1960) also reported in Clark and Trow (1966) 'The Organizational Context'.

They identify two functions of importance in defining student sub-cultures*.

Whilst not actually defining subculture in the true sense of the word, these variables provide a most useful starting point. The factors 'involvement with ideas' and 'identification with the College' can be dichotomised (high/low) identifying four extreme groups, shown in Table 4.1.

Table 4.1

Clark Trow Subcultural Typology

		Involvement with Ideas	
		High	Low
Identification with College	High	Academic	Collegiate
	Low	Non-conformist	Vocational

from Clark and Trow in Newcomb & Wilson (1966)

This rather simple structure can be criticised on a number of counts:

---

* Clark and Trow's use of the word 'subculture' is somewhat misleading, as shared perceptions is only one of seven criteria necessary to define a subculture, namely -- (1) an interacting group who (2) share language (3) share perception (4) have agreed non-verbal interaction patterns (5) have accepted rules and convention on action (6) have agreed moral values and (7) shared technology and material culture (Argyle, 1969). For this reason, identification with a particular idea set can only be regarded as common orientation rather than defining subcultural membership.

1. The non-conformist group tends to be made up of those who do not fit really into one of the other three. It is therefore not an identifiable homogeneous group. Clark and Trow (1966) state that:

> The nonconformist subculture eludes easy characterization. It may, in fact, constitute a residual category, concealing within it quite different kinds of attitudes and orientations, some of which are on the rise, some of which are declining in their importance. Here, next to the fashionable bohemians and the compulsive rebels are those who already exhibit in college the radical cosmopolitanism and skepticism, the commitment to abstract ideas, and the alienation from merely 'institutional' attachments that are marks of the intellectual. (p.24.)

A restructuring of this typology could enable this class of student to be properly represented.

2. The suggestion that the vocationally oriented student is not interested in ideas ignores the fact that whilst their range of interest is restricted, it is deep and intensive within their field of speciality.

3. 'Identification with the College' is too broad, going well beyond the boundaries of intellectual interest, to include social, political and recreational interests.

The restructuring of this typology follows directly from these criticisms:

1. Involvement with ideas is split into two variables -

Amount of Intellectual Activity and Diversity of Intellectual Activity. A third variable, Depth of Intellectual Activity is linealy related to the first two, and need not be defined. Notionally, Amount = Diversity x Depth, hence High Amount/Low Diversity implies 'High' Depth and Low Amount/High Diversity implies 'Low' Depth.

2. Identification with the College should be narrowed to the acceptance of the Colleges intellectual standards and goals, or more accurately Motivation to meet externally set goals and standards. This factor is similar to one proposed by Gamson (1967b).

If one were to consider the extreme (High/Low) cases for each variable, eight groups or types are identifiable. (See Table 4.2).

Table 4.2

Revised Student Goal Orientation Typology

		Amount of Intellectual Activity (Volume)			
		High Diversity of Ideas (Breadth)		Low Diversity of Ideas (Breadth)	
		High	Low	High	Low
Motivation to meet externally set goals and standards. (Motivation)	High	Scholar	Academic	Dilettante	Swot
	Low	Intellectual	Vocational	Flitter	Misfit

The Scholar is the epitome of the University student. Concerned with a wide range of ideas studied at depth. He conforms to the universities goals and expectations. He is most like Clark and Trow's Academic Culture, Warren's (1966) Academic Orientation, and Pemberton's (1963) Academic - Theoretical Orientation.

Ellis, Parelius and Parelius (1971) defined a class of student called the Collegiate-Scholar, a variation on Clark and Trow's typology, which is not unlike the Scholar of this typology. (Academic plus collegiate). They show this type to have an elite status academically and socially.

The Academic restricts his attention to the academic studies put before him by the University. He is a specialist, unlike the Scholar who is a generalist. He is most like Pemberton's (1963) Academic Conformity Orientation, Keniston (1966), The Professionalist, Koenig, Flacks et al (1963) The Scholars, and Schumer and Schofield (1966) Academic and Scholarly Role Orientation.

The Intellectual is very much like the Scholar, but determines his goals and standards from outside the university environment. He seeks to use his learning to answer social or other issues he sees in the wider community, or issues from his own philosophy. He is much like elements of Clark and Trow Non-conformits Culture, Warren's Intellectual Orientation, Pemberton's Non-conformity Orientation, Newcomb,Koenig, Flacks et al Creative Individualists, and Schumer and Stanfields Intellectual Role Orientation. Non-conformist is too wide a title, and intellectual is chosen, as it closely resembles Bottomores description of ... 'those who contribute directly to creation, transmission and criticism of ideas; they include writers, artists, scientists, philosophers, religous thinkers, social theorists (and) political commentators'. (Bottomore; 1964, p.70).

The Vocational student is like the Academic, a specialist, who like the Intellectual takes his goals and standards from professional bodies outside the University. (The Academic sees his Professional Body as the University). He is now attributed with thinking (High Amount), in contrast to Clark and Trow's description (Low identification with Ideas). He is most like the Vocational Orientation of Warren, the Technical-Vocational Orientation of Pemberton, the Apprentice of Keniston, and the General Vocational Role Orientation of Schumer and Stanfield.

The Dilettante is described by the Oxford Dictionary as '..... smatterer, one who toys with subject or concentrates on nothing'. He is closest to Clark and Trow Collegiate Culture, and Warren's Traditional Orientation. Trying to please the University, he tries bits here and there to find easy options and make the grade.

The Flitter is not unlike the Dilettante except that his motivation is to meet social needs, to gain recognition from peers and the community rather than the University. He is not unlike Pemberton Social Group Orientation, The Big Man on Campus described by Keniston the The Social Group of Newcomb, Koenig, Flacks et al.

The Swot works hard, thinks little and spends most of his time trying to get clues about examination papers. Desperate to get the best grades with the least effort he spends his time studying past examination papers. He is like Warren's Conformist Orientation, and Keniston's Underachiever.

The Misfit, so named because in an institution who's prime interests are intellectual he appears to have no place, tends to regard the University as a purely social environment. The Vocational Culture as described by Clark and Trow fits this class, as does the Autonomous Orientation, the Social Protest Orientation, the Self Centred Orientation and the Undirected Orientation of Warren, the Activist, the Disaffiliate and the Gentleman in Waiting of Keniston, the Wild Ones and the Political Activists of Newcomb Koenig, Flacks et al, and the Consumatory Colegiate Role Orientation, the Instrumental Collegiate Role Orientation, the Orientation to Greek-letter System, the Social Development Role Orientation and the Ritualistic Role Orientation of Schumer and Stanfield. The appearnace that this class is a residual class (a criticism of Clark and Trow's Non-conformist Culture) arises from the mixing of social and intellectual variables in the typologies of the other writers.

The three variables defined earlier can be seen to enable the description of eight real types of student, that can be related to the observations and research of other writers.

4.1.2. Staff Role Orientation

Far less attention has been given to the development of modes of thinking characteristic of staff. Gamson (1967a) found a distinction in modes of thinking, one associated with the social sciences, the other with the natural sciences. Such a typology does not allow distinctions within a faculty to be made,and so has little potential for this study. McKeachie reports that little is known of teacher qualities important in teaching, after an extensive review of literature(1965). Clark (1963) developed a typology based on two factors, Identification with the College, and Commitment to Pure, Disinterested Work or Study. The dichotomising of these leads to the definition of four types - the Teacher (High identification and committed to pure study), the Scholar-Researcher (low identification, and committed to pure study), the Demonstrator (High identification, low commitment to pure study) and the Consultant (Low on both dimensions). These categories reflect a mode of administration that is not common in Australia (the use of outside consultants) and ignores some of the major activities involved in academic life.

An alternative view is suggested by Baird, who identifies three dimensions:

> The first dimension of the model of the classroom situation is based on the behaviors the instructor thinks are important and which he attempts to reward. These are a reflection of his own values, i.e., his interest in facts, people, or ideas. These interests determine his choice of a didactic, generalist, or researcher subject strategy. The didactic strategy emphasizes detailed knowledge of facts and comprehensive coverage of the field. The generalist strategy emphasizes the application and impact of the ideas and facts of the field in the lives of students. The teacher scoring high on this strategy values general knowledge and insight into current problems. The

> researcher strategy emphasizes the interpretation and analysis of information, and the current topics and disputes in the field.
>
> (Baird, 1971, p.2)

Feldman and Newcomb (1969) touch on these factors

> ....., the Faculty, who occupy a different position in the college structure, are primarily concerned with the areas of importance to them: teaching, research, and administration. (p.229).

which suggests an alternative typology that might provide a comprehensive measure of Staff Role Orientations.

Three factors can be identified: Preoccupation with the Institution (Administration), Preoccupation with Students (Teaching) and Preoccupation with Pure Research (Research). If one considers the extreme combinations, one can define eight types as before (See Table 4.3 below).

Table 4.3

Staff Role Orientation Types

(Institution/Teaching/Research)

(H,	H,	H)	Administrator/Teacher/Researcher
(H,	H,	L)	Administrator/Teacher
(H,	L,	H)	Administrator/Researcher
(L,	H,	H)	Teacher/Researcher
(H,	L,	L)	Administrator
(L,	H,	L)	Teacher
(L,	L,	H)	Researcher
(L,	L,	L)	Misfit

The descriptions of these labels require little further explanation. It is unlikely that there would be any single link between status in the institution and this typology, although one would not expect to find many, if any, in the misfit class. As the dimensions only cover academic life, they are not ipsative and high commitment could be seen in a staff member of all three criteria.

In contrast to the refined and well-supported SGO factors, the SRO dimensions are crude and unsupported. Their introduction provides an opportunity to determine whether the environment created by a lecturer is a function of his perception of his role, or of his perception of the student's goals, and also provides the opportunity to determine whether a student's reaction or response to a lecturer is to the value of the environment in meeting his goals, or in representing the appropriate lecturer role. In this way the SRO dimensions provide balance to the thesis.

The lack of previous research along similar lines to the one taken here prompted a minor survey to judge whether or not practicing educationists at tertiary level felt that the typologies were realistic. Confirmation of this would suggest that the underlying dimensions that generated the typology must also be valid.

Fourteen staff, nine from a Faculty of Education and five from a Chemistry Department were provided with a description of each type of student and each type of staff member printed on cards. The descriptions are shown in Table 4.4.

Table 4.4

Short Descriptions of Student and Staff Types

Student Type	Staff Type
Academic - is a deep but convergent thinker, who accepts as his goals and standards those prescribed by the university. He considers the university as the centre of specialisation and expertise, and as such is the appropriate institution to set intellectual standards.	**Teacher-Administrator** - this staff member combines teaching activities with administrative matters. He is not very interested in research. He is chiefly involved with curriculm committees, timetable organization, and with lectures, demonstrations and tutorials.
Intellectual - is a deep and divergent thinker, who does not consider the educational goals and standards of the university of importance, but rather sees learning important in its' own right, and sets his own standards. His goals relate to areas in the world and community at large, rather than restricted to areas within the university.	**Researcher** - this staff member is primarily involved with pure research activities. He sees his role in the university as pressing forward the limits of knowledge in his particular area. Students and administrative matters are very insignificant areas of involvement in his view of university life.
Flitter - is the type of student who is a shallow but divergent thinker who sees the university set standards and goals as artificial and unimportant. He could be considered as a pseudo-intellectual.	**Teacher-Researcher-Administrator** This staff member manages to balance three main areas of activity. Students, research and administrative matters form a unified whole, each relating to the other, without any one area dominating or ignored.
Misfit-is the student who does not consider the university set goals or standards of any importance, and is a shallow convergent thinker. As such he is quite out of place in an educational institution such as the university.	**Researcher-Administrator** - this staff member avoids involvement with students and concentrates on research activities and associated administrative matters. He has little time left for students.
Vocational - is a deep but convergent thinker, who sees his goals and standards as being set outside and beyond the university University represents a step on the way to a career and not an end in itself.	**Teacher-Researcher** - this staff member sees his role not only as an expert conducting research but also as a teacher, passing on his learning and expertise. He considers administrative matters as unimportant, or at least not his concern.

Table 4.4 (Cont'd.)

Student Type	Staff Type
Scholar - is a deep and divergent thinker, who accepts as his goals and standards those prescribed by the university. He considers the university as the centre of intellectual thought and as such it is appropriate for it to set standards.	Teacher - is primarily involved with students. His first consideration is to meet their needs, to be available when they require assistance with their work or in personal matters. He considers research and administrative matters as secondary to teaching.
Swot - is a shallow, convergent thinker, who sets great store by results and qualifications. He would tend to learn by rote, without understanding, limited areas of knowledge. He could be described as a pseudo-academic.	Administrator - is primarily involved in administrative matters in the institution. He takes part in the organization of many aspects of university life, and spends a considerable amount of time attending committee meetings. He engages in very little personal contact with students, if any, nor does he engage in research activities.
Dilettante - is a shallow, divergent thinker who considers the university as the centre of learning. He concentrates on nothing, but dabbles in everything, seeking and hoping for recognition within the university. He is in effect a pseudo-scholar.	Misfit - is an alien in a lecturing position as he has no interest in the advancement, organization, or dissemination of knowledge. There may be other reasons for his acceptance of a lecturing position, such as prestige or financial gain.

The staff were given a task to perform, which involved ranking each student type in order of compatability with each staff type, and ranking each staff type in order of compatability with each student type. Feedback from this exercise indicated that the staff had no problem identifying and understanding each type, and the consistency of ranking suggested that their understanding of each type was meaningful.

Rank correlation were determined showing trends between student groups that fit expectations. (Table 4.5).

Table 4.5

Rank Correlations between Student Types

	Intellectual	Flitter	Misfit	Vocational	Scholar	Swot	Dilettante
Academic	.83	.31	.12	.59	.79	.05	.35
Intellectual	-	.17	-.03	.39	.91	-.24	.14
Flitter	-	-	.94	.36	-.04	.03	.41
Misfit	-	-	-	.46	-.21	.24	.57
Vocational	-	-	-	-	.32	.68	.89
Scholar	-	-	-	-	-	-.20	.09
Swot	-	-	-	-	-	-	.86

The staff showed that they were less able to discriminate between staff-types on this exercise. This could be attributed to the feeling that student performance would be a simple function of their type, rather than arising from an interaction of type. A scan of Table 4.5 shows that student types could be clearly identified, and as they were devised from a ranking exercise with staff types, it can be inferred that staff types are also identifiable even if with less clarity.

This exercise substantiates the belief that the typologies are realistic and hence their generating dimensions are valid. Throughout the thesis, the SGO and SRO scales are treated as separate entities. They are measured in separate scales, validated separately and hypotheses are formed and tested separately. Codes are needed to represent dimensions and orientations, and these are listed in Table 4.6.

Table 4.6

Codes for Dimensions and Orientations

	Short Title	Code	Scale No.
Student Goal Orientation	Part B	SGO	-
Amount of Intellectual Activity	Volume	VOL	1
Diversity of Ideas	Breadth	BRE	2
Motivation to meet Externally set Goals and Standards	Motivation	MOT	3
Student Flexibility (to be introduced later)	Flexibility	FLEX	4
Staff Role Orientation	Part C	SRO	-
Preoccupation with Institution	Administrator	INST	5
Preoccupation with Students	Teacher	STD	6
Preoccupation with Research	Researcher	RES	7
Staff Autonomy (to be introduced later)	Autonomy	AUT	8

Style of Intellectual Functioning can be defined, then, in one of two ways; from the student perspective by the SGO dimensions, or from the staff members perspective by the SRO scales. These have been defined and related to previous typologies. In the next section the development of instruments to measure these will be discussed.

4.2. Development of Measures

4.2.1. Preliminary Requirements

Chapter 2 dealt in depth with the requirement that the measurement of the perceptual frame of reference or style of intellectual functioning must be measured in a phenomenological way. Self report techniques are required, and so a questionnaire or interview schedule must be developed (in contrast to an observation schedule). Interview schedules are cumbersome for such a purpose, and introduce interviewer/ interviewee interaction that could severely distort the results.

(i) The questionnaire has to be designed in such a way that inferences can be made from the responses about the internal state of the individual. To avoid marker bias, this must entail closed response (multiple choice) rather than open response questions. The use of closed responses also limits the reactivity of the test (the possibility of an emotive individual answer affecting later answers) and constrains the thinking of the responder to the appropriate dimension. (For example, without closed responses, he may indicate that he agrees with the item, likes the item, would like to see the item, doesn't believe that the item represents reality whilst agreeing it is desirable and so on). By closing response, all respondents must indicate their preferences on a single criterion. On reliability, reactivity and validity grounds, therefore, the closed response mode is preferred.

(ii) The questions must be discreet, giving little, if any, indication of the underlying structure (Hall, 1970). This implies many items to measure each dimension rather than one. An extreme example of a blatant questionnaire, based on the Clark and Trow typology presented detailed descriptions of each of the four types, and asked respondents to indicate with which statement they identified (Gottlieb and Hodgkins, 1963). This direct approach may have face validity, but there is little doubt that the students could identify the least desirable type and the most desirable type from the universities viewpoint (the Academic, the Vocational respectively) and this would distort the observations considerably.

(iii) The scales measuring each dimension are continuous rather than discreet in nature. Any degree of involvement is possible, so the instrument should reflect this variation. It is not the intent of the research to type students into one of the eight SGO categories, but rather to indicate their position on three dimensions. They may fall between types, rather than within types. This reinforces the point made previously, that the scales need to be measured by multiple items, each with multiple levels of response.

(iv) The type of scaling to be used is the next issue for resolution. A number of techniques are available, notably Thurstone Scales (1928), Likert Scales (1932), Scalogram Analysis, Guttman (1944) and Latent Structure Analysis, Lazarsfield (1960). The advantage and disadvantage of these techniques are well documented elsewhere (Torgerson 1958) and do not require expansion here. Likert's technique, involving the addition of scores on items to produce a scale total, makes minimal demands on the probability model underlying the responses (apart from the requirement that it be monatonic, i.e. the probability of endorsement of an item increases monotonically with strength on the dimension being measured) and provides a score highly correlated with the 'real' position of the respondent on the dimension being measured.

(v) The decision between a four point scale (even) or a five point scale (odd) had to be settled. A five point scale has a mid-range response

response (uncertain), and was rejected on the following grounds:

(a) The mid-range response is not a range but a point. It tends to be overused because of apathy, and because respondents not understanding the question would choose it. One should expect to find an extremely small number of responses in this range. (See Figure 3.1).

(b) the spreading of the distribution by according the 'uncertain' response an interval could artificially inflate reliability indices, and polarise groups.

(c) The use of four point scale forces a choice. Individuals who could not answer were asked to leave items blank. In fact fewer than 1 percent of possible responses were unmarked. (See Chapter 5).

These conclusions concur with Holdaway (1971) who conducted an empirical study of the problem.

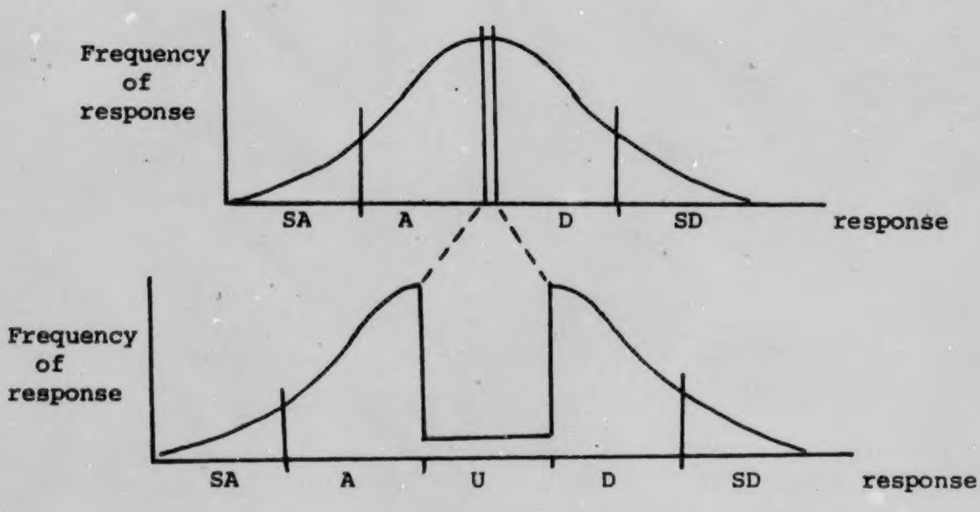


Figure 4.1

Response distributions on four and five point scales

(vi) The questionnaire must meet the requirements of unreactivity, efficiency, reliability and validity. These are maximised in the following ways:

(a)	Unreactivity:	avoidance of emotive or extreme statements
		simplicity of format and style
		consistency in mode of response
		careful explanation of purposes and assurances of anonymity
		balance between positive and negative statements
		ungrouped dimension scales (random or systematic distribution)
		multi-faceted approach.
(b)	Efficiency	sensitivity increased by ensuring extreme responses possible
		discrimination increased by ensuring item uniqueness and common factor loadings.
(c)	Reliability	dependability increased by ensuring test unpaced, item stem short, instructions clear, items not ambiguous.
		administrative reliability increased by ensuring that administrative intervention unnecessary.
		conspect reliability maximised by machine scoring.
		presophistication reduced by multiple items.
(d)	Validity	content validity maximised by use of 'expert' judges, previously used items, careful selection from the 'universe' of items.
		construct validity maximised by logical development of scales based on a sound theoretical framework.

These, and other techniques were used to ensure maximum quality in the design of the instruments. The outcomes of these efforts are described in Chapter 5.

(vii) The resultant scales should not differentiate between teachers or a group and students or a group. There should be considerable overlap between the groups. Feldman and Newcomb warn that this is not always the case:

> Given that students and faculty have different locations in the structure of the college and thus have different areas of concerns and problems, it mught be expected that each group would develop a somewhat distinctive culture -- that is, distinctive shared sets of understandings about the environment and distinctive shared sets of actions congruent with those understandings. Moreover, since faculty and students represent different age groups and generations -- Wallace (1966) goes so far as to caricature the interaction between students and teachers as a 'bureaucratized confrontation of generations' -- we might also expect that faculty and students differ in certain personality traits, attitudes, and values quite apart from any differences in orientation generated by their different roles in the social structure of the college. (Feldman and Newcomb, 1969, p.229)

However, careful selection of items can produce scales that provide the necessary overlap, and in such cases one will find that:

> The differences between the faculty and students are average differences and they are not always large. There is probably a good amount of overlap between the distribution of scores of the two groups, and in some cases the student-faculty differences are merely differences within relative similarity.'
>
> (Feldman and Newcomb, 1969, p.231).

The seven major requirements described on the previous pages were each kept in mind in the development of the SGO and SRO scales.

4.2.2. Selection of Items and Construction of Instruments

For both the SGO and SRO scales, the same pattern of development occurred:

1. Selection and classification of items
2. Content validation and criticism by experts
3. Compilation of selected items to form pilot Questionnaires.
4. Administration and analysis of Pilot Questionnaires.
5. Selection of final scale items and preparation of final Questionnaire.

In this section, steps one to three will be discussed.

1. Selection and Classification of Items

Item banks were established for each of the six scales and the literature searched for items that had potential value in measuring those scales. Items were selected from a range of sources including those reported by Feldman and Newcomb (1969 Volume 2), and from Questionnaires used in Australia by Katz and Katz (1968) and Katz, Magin and Arbib (1969).

Of the initial pool of 98 items 60 were selected. (The 38 others were rejected mainly on the grounds that they repeated other items, or that they were ambiguous or meaningless in the Australian context). Additional items were then constructed to complete scales, bringing the total to 69, distributed across the scales as shown in Table 4.7.

Table 4.7

Initial Distribution of Items

Scale	VOL	BRE	MOT	INST	STD	RES
No. of Items	11	11	13	10	13	11

Items were also constructed to measure six of the student type groups directly (Dilettante and Swot were not included). Five items were constructed for each type, making an SGO questionnaire of 65 items and an SRO questionnaire of 64 items. In addition, 16 items related to general university educational practices were collected, and 26 items were collected dealing with specific teaching activities and staff roles. These were later used in the pilot questionnaire for validation purposes.

2. Content Validation by a Panel of 'Experts'

Nine staff from a Faculty of Education, and five from a Department of Chemistry were supplied descriptions of eight student types and the eight staff types. They were then asked to answer the collected SGO and SRO items, role playing each type of student and staff member in turn. Their responses were checked against ideal response sets, and this enabled the elimination of a further nine items, reducing the scale sets as shown in Table 4.8.

Table 4.8

Pilot Scale Item Numbers

Scale	VOL	BRE	MOT	INST	STD	RES
No. of items	10	10	10	9	12	9

3. Compilation of Selected Items to form Pilot Questionnaires

The questions selected for the Pilot SGO questionnaire are given in Table 4.9, and for the Pilot SRO questionnaire in Table 4.10.

Table 4.9

Items in Pilot SGO Questionnaire

Scale		Item
Amount (VOL)	2.	Tertiary education should develop the intellect.
	3.	Tertiary education should encourage students to think in depth.
	9.	Tertiary institutions should provide facilities for students to engage in extensive study.
	10.	Emphasis should be placed on providing facilities for sports and social activities at tertiary institutions.
	22.	Tertiary institutions should indicate clearly what the minimal requirements for a pass are.
	34.	The working year is too short at this institution.
	35.	A Tertiary institution should insist that all students engage in some non intellectual activities.
	38.	Examination results should be given as pass/fail only.
	47.	Tertiary institutions should employ lecturers who can get the maximum number of people up to examination standard with the minimum of student effort.
	51.	Tertiary institutions should employ lecturers who stimulate students to think deeply in their subjects.
Diversity (BRE)	6.	Tertiary education should develop a lively intellectual interest in a wide range of topics.
	25.	Tertiary education should help one develop an understanding of world issues.
	26.	Tertiary education should emphasise a deep involvement with art or ideas, whether scientific or humanistic.

Table 4.9 (Cont'd.)

Scale		Item
Diversity (BRE) (Cont'd.)	39.	Tertiary education should aim to develop in the individual a personal philosophy of life.
	40.	Tertiary education should train students to become adept in a narrow field.
	41.	Extensive libraries should be provided so that a student may read in areas outside his particular course.
	44.	Tertiary education should provide a specialised understanding of one field of knowledge.
	54.	Tertiary education should serve to widen one's intellectual experience.
	56.	Tertiary institutions should encourage freedom of thought.
	59.	Tertiary institutions should provide an environment where a student's special interests can be nurtured.
Motivation to meet externally set goals and standards (MOT)	8.	Formal examinations should not be used at tertiary institutions.
	20.	Any kind of assessment is contrary to the ideals of a tertiary education.
	31.	The failing of passing of an examination is not as important as the learning that preceeded it.
	37.	Tertiary institutions should assess students in as many different ways as possible.
	43.	Assessment is necessary if standards are to be maintained.
	46.	Examinations provide the opportunity for one to gain recognition for one's efforts.
	50.	An examination is necessary so that one can prove to others that one is qualified.
	52.	One should set one's own goals and standards - no one else can do it for one.

Table 4.9 (Cont'd.)

Scale	Item
Motivation to meet externally set goals and standards (MOT) (Cont'd.)	53. Examiners should keep in mind the individual needs of each student in setting and marking examination papers.
	60. Tertiary institutions should set clearly defined examination standards.
Scholar	17. It is important that a student reads widely and becomes skilled in many different fields.
	19. An educated man is one who is 'a Jack of all trades' and a master of all of them.
	23. Examinations should encourage divergent thinking.
	32. Tertiary education should satisfy one's intellectual curiosity in diverse fields.
	36. More credit should be given to those who spread their intellectual interests over many fields, than to those who direct all their attentions at one area.
Academic	13. Intellectual specialisation is needed these days.
	15. It is better to study in depth in one field than to try to be expert in many.
	16. Tertiary education should provide a highly intensive, specialised understanding
	27. Tertiary education enables one to come into contact with experts in one's field of interest.
	28. More credit should be given to those who strive to become expert in a particular field, than to those who dabble in many areas.
Flitter	11. It is better to have a wide education, even if you don's do well in examinations.
	42. Sport, social life and club activities are the most important aspects of student life at a tertiary institution.

Table 4.9 (Cont'd.)

Scale	Item
Flitter (Cont'd.)	48. Tertiary education should develop one's ability to get along with other people.
	49. Tertiary education should serve to develop one's knowledge of community and world problems.
	58. The main purpose of a tertiary education is to make friends and contacts for later years.
Intellectual	5. Education must serve as a catalyst for change in our society.
	18. Examinations serve to retain the status quo - they imply static, absolute standards. Students should be freed from their grip.
	33. The more one learns, the more one realises that one's learning is needed to improve society.
	55. Tertiary education should encourage an active interest in world problems.
	57. Tertiary education is a stepping-stone to the world of wider influence and importance - the world of politics and social reform.
Misfit	1. Tertiary institutions are no more than child minding centres for overgrown children.
	4. The best way to learn is on the job, not at a college or university.
	7. The social, sporting and intellectual life of a tertiary institution is all a big sham - a poor copy of the outside world.
	12. Education's only use is to give you a good life.
	14. The tertiary institution simply serves to protect the individual from the harsh realities of the outside world. It has no other function.

Table 4.9 (Cont'd.)

Scale	Item
Vocational	21. Tertiary institutions should recognise that their role is simply to prepare a person for a job.
	24. The purpose of tertiary education is to develop skills and techniques directly applicable to a career.
	29. Tertiary education enables one to get a qualification in order to obtain a better job.
	30. Success in a job is of more importance than success in examinations.
	45. Courses and examinations should make some attempt to imitate conditions in occupations outside the institution.
General Educational Issues	61. The best way to find out what we are here to learn is to look at past examination papers.
	62. There is insufficient opportunity to get to know lecturers informally.
	64. It is often difficult to find lecturers who will listen to your problems.
	65. The lecturers here seem to be mainly interested in research and not in teaching.
	67. There is too much work expected of us here.
	68. We are not given any ideas about the objectives of the courses here.
	69. I have a great deal of respect for this place as a teaching institution.
	71. I have a clear educational goal in mind that I am determined to attain.
	73. I have a great deal of respect for this place as a research institution.
	76. Students should have a say in the planning of courses.

Table 4.9 (Cont'd.)

Scale	Item
Flexibility	63. It is easy to adjust to different teaching styles.
	66. One expects different methods of instruction in different subjects.
	70. When lecturers have different views of tertiary education students become confused about what to learn.
	72. The staff seem to hold different views of the purpose of our education here.
	74. I find it pretty easy to adjust to ne surroundings and ideas.
	75. To do well, it is wise to find a lecturer who holds the same views as you do.

Table 4.10

Items in Pilot SRO Questionnaire

Scale		Item
Administration (INST)	2.	Insist that his status as a staff member should be recognised by the students.
	24.	Be in agreement with current institutional practices in teaching, research, and other activities.
	26.	Be involved in activities outside the institutions and away from students.
	29.	Participate in the administration of courses.
	30.	Participate in policy-making committees.
	33.	Be prepared to act as a spokesman for the college or university.
	39.	Participate in the administration of student disciplinary measures.
	49.	Avoid involvement in administrative matters.
	54.	Participate in the organisation of activities outside his particular field of interest.
Students (STD)	10.	Join students in their leisure activities.
	14.	Treat students as equals rather than as subordinates.
	21.	Be willing and available to talk to students about a wide range of academic, social or personal problems that they might have.
	28.	Be available when students want to talk with him.
	32.	Not favour particular students.
	40.	Be willing to go to the administration on behalf of the students.

Table 4.10 (Cont'd.)

Scale	Item	
Students (STD) (Cont'd.)	41.	Be patient with students who stress their own individuality.
	43.	Encourage students to adopt radical views about religion, politics or morality.
	46.	Discuss political and social issues with students, even if they are unrelated to their courses.
	52.	Know something about the future plans of individual students.
	53.	Encourage students to join professional associations.
	55.	Be able to speak to the students at their level and be conversant with their culture.
Research (RES)	4.	Have considerable ability in carrying out research.
	5.	Be a well known authority in his field.
	6.	Read widely on all topics, not only those directly related to his field.
	13.	Set aside much of his time for conducting research.
	23.	Base his lectures on recent findings in research, particularly his own.
	25.	Encourage students to participate in exploratory or research projects.
	27.	Be given a sufficiently light student-contact load, so that demanding research projects can be carried out.
	36.	Be encouraged to keep up with the latest developments in his field by practical means such as grants and/or study leave.
	51.	Be encouraged to publish reports in recognised journals.
Educational Practices	1.	Take time to learn about the student's level of ability in his subject.

Table 4.10 (Cont'd.)

Scale	Item
Educational Practices (Cont'd.)	3. Really encourage students to think for themselves.
	7. Encourage students to question seriously his (the staff member's) interpretation and conclusions in class.
	8. Present opposing viewpoints and encourage students to make up their own minds.
	9. Encourage students to pursue independent study.
	11. Really talk with students, not just at them.
	12. Advise students in selecting courses and working out a programme of studies.
	15. Spend time hleping a student with his or her own special learning problems.
	16. Give student a fair warning if they are not doing so well in his course.
	17. Be patient with students who do not seem to understand what is presented.
	18. Consider the Student's needs and interests in planning his course.
	19. Stimulate curiosity about areas of knowledge outside the particular course.
	20. Stimulate curiosity about particular areas of the course.
	22. Know how to interest students.
	31. State the objectives of the course explicitly in the handbook or in distributed notes.
	34. Actively study the objectives of the course when setting examinations.
	35. Ensure that courses he teaches are an adequate preparation for later work.
	37. Undertake frequent assessment of students to provide remedial attention if required.

Table 4.10 (Cont'd.)

Scale		Item
Educational Practices (Cont'd.)	38.	Adjust his assessment techniques according to the needs and the aims of the individual student.
	44.	Refer to the objectives of the course when setting standards for marking examinations.
Lecturer Autonomy	42.	Agree to the demands of organizations outside the college or university to modify courses.
	45.	Be able to teach and examine in any way he chooses.
	47.	Be able to select the content matter of courses, free from direction by others in the institution.
	48.	Strive to maintain the intellectual image of his college or university.
	50.	Encourage and support proteges.
	56.	Take note of students' comments about courses.

The inclusion of the extra items had two purposes:

(1) to provide a larger pool of items for validation of trial scale items, endorsed by checking logical relationships; and

(2) to provide a comparative measure between this study and others conducted using those items.

The questionnaires were prefaced by an explanatory comment and a biographical questionnaire. Items were placed randomly through the questionnaire, except for the sixteen SGO Educational Practices items which followed the others in a group.

Table 4.6 introduced two scales, Student Flexibility (FLEX) and Staff Autonomy (AUT). These were introduced to cater for the possibility that highly flexible students may be able to adapt rapidly to changing lecturer styles, and hence render the main study invalid, or that staff may not feel sufficiently autonomous to express their own ideas in their teaching. Only the second of these scales (AUT) was piloted in this trial, and it was eventually determined that neither were necessary (Chapter 6).

4.3. The Pilot Trial of the Questionnaires

This section provides a condensed description of the pilot trial of the instruments.

A total of 160 students were administered the SGO questionnaire at a voluntary meeting during class hours. This represents 50% of the total first year diploma (primary) class. No sampling biases were detected, all course combinations allowed were represented in the sample. The method of sampling, however, is likely to introduce a bias that would result in missing groups, rather than distortion of data obtained. Later studies will measure complete populations, rather than samples, in order to overcome this deficiency.

Table 4.11

Comparison of sample and population means on objective type variables

Variable	Sample	Population
Sex (percentage male)	18%	17%
Socio-economic status[a]	4.8	n.a.
Age (years)	18.6	n.a.
Anderson score[b]	187	187 median
First year achievement[c]	256	250
Number	160	317

a as measured by occupation of the head of the household rated on Congalton's seven point scale.

b the sum of the best three Higher School Certificate marks.

c the sum of the standardised scores on the five subjects undertaken by each student.

n.a. not available.

The sample consisted of 27 men and 133 women, reflecting the imbalance of the sexes existing at the college. Age ranged from 17 to 22 years. Only one student was not supported by a studentship. Socio-economic status (S.E.S.) as measured by the occupation of the head of the household scaled on Congalton's (1969) seven point scale, ranged from 1.87 to 7.46, with a mean value of 4.76. (In effect this covers the complete range of occupations, the mean occupation being the equivalent of a plumber, land agent, tenant farmer or industrial foreman. As primary teachers are rated in the same scale at 4.30, (high status occupations score low on this scale) for most students the training represents an upward mobility step. There is no significant difference between the sexes in S.E.S. Sixty-six percent of the students in the sample were living at home with their parents, 21% at the college hostel, 9% in a shared flat or house, 3% were boarding with friends or relatives, and 1% had their own flat or house.

The SRO questionnaire was administered to twenty-six staff members and the primary teachers' college. This amounted to 54% of the total group who lecture to first year students at the college. Subsequent investigation showed that the sample was not biased with regard to the distributions of sex, subject area or number of qualifications. There are undoubtedly undetected biases that may affect the results, so care must be taken in the interpretation of them

All subject areas except philosophy of education and educational sociology type subjects were represented in the sample. Age ranged from 22 to 55 years with a mean of 32.5 years, and experience from zero to 22 years, with a mean of 8.96 years. The sample consisted of 19 men and 7 women. Most had at least two qualifications (18), seven and three, and only one had one qualification. The results of this item analysis for each scale are given in Table 4.12. Cronbach's α coefficient is discussed fully in Chapter 4.5.

Table 4.12

Item Analysis of Pilot SGO and SRO Scales

		Cronbach α	No. of Items
SGO	VOL	.29	10
	BRE	.62	10
	MOT	.36	10
	SCHOLAR	.45	5
	ACADEMIC	.53	5
	FLITTER	.48	5
	INTELLECTUAL	.56	5
	MISFIT	.43	5
	VOCATIONAL	.51	5
	FELXIBILITY FLE	.29	6
	OTHER ITEMS	.40	10
SRO	INST	.63	9
	STND	.78	12
	RES	.67	9
	AUT	.38	6
	OTHER ITEMS	.84	20

When item discrimination was investigated a number of items were found to be unsatisfactory, requiring removal or alteration. Three from the SGO scales and eight from the SRO scales (based on a requirement that the probability of a given item-scale correlation should be less than .02).

Item grouping was also checked using a cluster analysis technique, which incorporated an initial R mode analysis, (Mather; 1969). Items from the three SGO and three SRO scales were analysed separately. The analysis produced three groups in both cases, which did not differ significantly from the groupings hypothetically constructed.

(X^2 = 24.9 d.f. = 4, $P<.0001$ for the SRO scales, and X^2 = 13.3, d.f. = 4, $p<.01$ for the SGO scales). Cluster analysis was also conducted with the scores of the subjects on these scales to determine student and staff groupings. Whilst no groupings were found that matched the hypothesised pattern exactly, approximate match was observed.

Summarising characteristics of these groups as revealed by answers to the questionnaires is difficult, but it could be said that one group of staff showed a deep involvement with students both on an academic level and a personal level, and were prepared to conduct research or participate in administrative matters only if these activities are in the interest of the students. They seemed to be more ready to accept teaching practices generally acknowledged to be 'good' and to have a greater autonomy than other groups. The second group was quite the opposite in this regard. They appeared to be opposed to the standard expectations of a staff member, particularly as concerns interest in students. A third group of staff had a deeper interest in the professional side of teaching. Research activities, and the encouragement of divergent or free thinking were characteristic of this group.

Students fell into six groups (named by number). Group 1 felt the best way to learn is on the job, not at a college or university. There was a pronounced concern in this group with the standing of qualifications in the eyes of others. (This did not seem to be related to actual performance in examinations as in both Higher School Certificate (H.S.C.) and the first year results this group did no better than average). Group 2 appeared to feel threatened by assessment, and confused by diversity or breadth in a course. The group had a very high proportion of males (29%) and was below average in performance. The members of the group felt happier to tackle one thing at a time.

The anti-intellectual, pro-vocational feeling was very strong in Group 3. Their aim was to achieve minimal qualifications with the least effort in order to get a job, a job which need not have any social or personal value.

Group 4 preferred the sheltered, familiar life associated with their college, in preference to concern and action in the 'outside world'. It is interesting to note that this viewpoint appears to be beneficial, as this group, which was well below average in H.S.C. marks, was the top group in first year achievement.

Even more unusual is the finding that Group 5, a group well below average in both Higher School Certificate and first year diploma results, valued intellectual activities very highly. The items suggested that they liked to define 'intellectual' in their own way. They could be called 'pseudo-intellectuals', claiming to be cosmopolitan in their approach to life.

The items that characterise group 6 formed a picture of an 'intellectual' group, in the sense that Bottomore (1964,1970) uses the word (creative, critical, individualistic). They accepted examinations as a necessary evil, and performed in them extremely well (the group averages well above the mean in both H.S.C. and first year diploma results).

The groups could thus be labelled as shown in Table 4.13.

Table 4.13

Groups Identified in the Pilot Test

SRO	Group A	Teachers
	Group B	Administrators
	Group C	Researchers
SGO	Group 1	Vocational
	Group 2	Swot
	Group 3	Dilettante
	Group 4	Academic
	Group 5	Flitter
	Group 6	Intellectual

The pilot trial of these instruments enabled a number of significant conclusions to be reached:

(1) the scales are substantially sound, and with modifications suggested by discrimination indices (such as rewriting items) they should prove to be of good quality;

(2) the items do seem to experimentally group together into the scale groupings of their origin;

(3) the subjects appear to group into rough approximations of six of the eight extreme groups (students) and three of the eight groups (staff);

(4) the direct measure scales in the SGO Pilot questionnaire are redundant, as the three factor scales (VOL, BRE, MOT) taken together provide meaningful measures. Items not

contributing to the main scales in both the SRO and SGO questionnaires will be dropped as they have served their function of validating the main scales.

The changes made to individual items are listed in Table 4.14. Minor rewording indicates change from 'College' to 'University', or 'tertiary institutions' to 'Universities'.

Table 4.14

Changes to Pilot Questionnaire

Scale	Item	Action	New Item No.
VOL	2	Reword (minor)	32
	3	No change	10
	9	Reword (minor)	24
	10	Reword (stress)	1
	22	Reword (lecturers should ....)	13
	34	Reword (minor)	16
	35	Reword (minor and stress)	7
	38	Not used	-
	47	Reword (minor)	20
	51	Reword (minor)	4
	-	New item	28
BRE	6	Reword (minor)	2
	25	Reword (minor)	21
	26	No change	29
	39	Reword (minor)	14
	40	Reword (minor)	11
	41	Major changes	33
	44	No change	5
	54	No change	8
	56	Negate	17

Table 4.14 (Cont'd.)

Scale	Item	Action	New Item No.
BRE (Cont.d.)	59	No change	25
	8	Reword (minor)	26
	20	Reword (minor)	6
	31	No change	12
	37	Reword (minor)	3
	43	No change	22
	46	No change	30
	50	No change	15
	52	No change	18
	53	No change	9
	60	Not used	-
	-	New item	34
FLEX	63	No change	19
	66	Not used	-
	70	No change	27
	71	Item from another scale	31
	72	Cut	-
	74	Reword (minor)	23
	75	Reword (minor)	35
INST	2	Reword (minor)	13
	24	Negate	4
	26	No change	16
	29	Reword (emphasis)	10
	30	No change	20
	33	Reword (minor)	7
	39	No change	28
	49	No change	32
	54	No change	1
	-	New item	24
STD	10	Not used	-
	14	Negate	33
	21	Not used	-
	28	Negate	11

Table 4.14 (Cont'd.)

Scale	Item	Action	New Item No.
STD (Cont'd.)	32	Not used	-
	40	No change	14
	41	No change	29
	43	No change	21
	46	Negate	17
	52	No change	8
	53	Negate	5
	55	No change	2
	-	New item	25
RES	4	No change	30
	5	No change	22
	6	Not used	-
	13	Negate	12
	23	Rewrite	34
	25	Negate	6
	27	No change	3
	36	No change	9
	51	No change	15
	-	New item	18
	-	New item	26
AUT	42	Not used	-
	45	No change	19
	47	Reword (minor)	23
	48	Reword (minor)	31
	50	Not used	-
	56	Reword (minor)	27
	-	New item	35

4.4. The Final Questionnaires

The final form of the questionnaires consisted of three parts, Part A (Biographical Details), Part B(SGO) and Part C(SRO). There were three forms constructed Form I Staff, Form II Students (first administration) and Form III Students (second administration). Details of these will be given at the conclusion of this section.

The three questionnaire forms are shown in full in Appendix I. The SGO Scales now consisted of thirty-five items, ten each on three scales, distributed systematically, and five on the flexibility scale. The distribution of the items is shown in Table 4.15.

The SRO Scales also consisted of thirty-five, ten each on three scales, distributed systematically, and five on the autonomy scale. The distribution of these items are also shown in Table 4.15.

Table 4.15

Distribution of Items

Scale						PART B					
1	VOL	1	4	7	10	13	16	20	24	28	32
2	BRE	2	5	8	11	14	17	21	25	29	33
3	MOT	3	6	9	12	15	18	22	26	30	34
4	FLEX						19	23	27	31	35
						PART C					
5	INST	1	4	7	10	13	16	20	24	28	32
6	STD	2	5	8	11	14	17	21	25	29	33
7	RES	3	6	9	12	15	18	22	26	30	34
8	AUT						19	23	27	31	35

Negative items underlined.

The final balance of content of each scale, with explanatory comments, can be seen in Table 4.16. Short description passages are added to item groups for clarification in this Table.

Table 4.16

Final Test Items

Amount of Intellectual Activity (Emphasis on Intellectual acitivities)

To what extent can social and sporting activities be tolerated if they must be undertaken at the expense of intellectual activities?

1. Great emphasis should be placed on providing facilities for sports and social activities at universities. SD D D SA

7. The university should insist that *all* students engaged in some non-intellectual activities. SD D A SA

What is the main purpose of a University? What is the role of a lecturer as regards student learning?

32. A university education should serve to develop the intellect. SD D A SA

10. Tertiary education should encourage students to think in depth. SD D A SA

4. Universities should employ lecturers who stimulate students to think deeply in their subjects. SD D A SA

With regard to the controversy surrounding pass rates, should lecturers 'lower their standards' in order to increase pass rates?

20. Universities should employ lecturers who can get the maximum number of people up to examination standard with the minimum of student labour. SD D A SA

13. Lecturers should clearly indicate what are the *minimal* requirements for a pass. SD D A SA

Do you expect students to devote most of their time to study? Should the teaching year be extended? Does tertiary education demand too much of a student's time?

24. Universities should provide facilities for students to engage in extensive study. SD D A SA

Table 4.16 (Cont'd.)

16. The working year is too short at this university. SD D A SA

28. These are the best years of your life and should not be wasted on study. SD D A SA

Diversity of Intellectual Activity (Specialisation versus diversity)

Should a student try to study a wide variety of subjects, or should he focus his attention on one field or a related set of fields?

2. A university education should develop a lively intellectual interest in a wide range of topics. SD D A SA

8. Tertiary education should serve to widen one's intellectual experience SD D A SA

5. Tertiary education should provide a specialised understanding of one field of knowledge. SD D A SA

11. A university education should train students to become adept in a narrow field. SA D A SA

Should the university try to develop independence in the student? Should it encourage free thinking amongst students, even to the point of revolutionary thought? Should it try to develop social conscience in a student?

17. It is not the purpose of a university to encourage freedom of thought. SD D A SA

14. A university education should aim to develop in the individual a personal philosophy of life. SD D A SA

21. A university education should help one develop an understanding of world issues. SD D A SA

29. Tertiary education should emphasise a deep involvement with ideas whether scientific or humanistic. SD D A SA

Table 4.16 (Cont'd.)

Should the university encourage division between areas by subject course limitations and departmental libraries?

33. The establishment of departmental libraries, containing only texts directly related to one area of specialisation, is preferable to larger multi-disciplinary libraries. SD D A SA

Willingness to meet Externally set Goals and Standards

What wole(s) do examinations play at university? Are they valuable in themselves, a necessary evil or an imposed evil? Should they be replaced by other forms of assessment? If so, what forms?

34. Examinations distort the true purpose of tertiary education - learning for it's own sake. SD D A SA

3. Universities should assess students in as many different ways as possible. SD D A SA

6. Assessment is contrary to the ideals of a university. SD D A SA

26. Formal examinations should not be used at universities. SD D A SA

Should students have a choice of questions or a say in the form of examination to better suit their needs?

9. Examiners should keep in mind the individual needs of each student in setting and marking examination papers. SD D A SA

What are your thoughts on the following frequently voiced opinions?

12. The failing or passing of an examination is not as important as the learning that preceded it. SD D A SA

22. Assessment is necessary if standards are to be maintained. SD D A SA

15. An examination is necessary so that one can prove to others that one is qualified. SD D A SA

Table 4.16 (Cont'd.)

30. Examinations provide the opportunity for one to gain recognition for one's efforts. SD D A SA

Do exams impose a specific way of thinking on students? Is this bad? Should students have a greater say in examining procedures?

18. You should set your own goals and standards - no one else can do it for you. SD D A SA

Flexibility (Likelihood of Change over time or in varying situations)

How easily can you adapt to different lecturers, and how important are those differences?

19. It is easy to adjust to different teaching styles. SD D A SA

27. When lecturers have different views of a university education students become confused about what to learn. SD D A SA

35. What would do better if you held the same views as your lecturers. SD D A SA

23. It is difficult to adjust to new surroundings and ideas. SD D A SA

How fixed is your perception of your goals?

31. I have a clear education goal that I am determined to attain. SD D A SA

Preoccupation with the Institution (Administration)

How important do you think administrative activities are on campus? Is it detrimental for a lecturer to limit his activities to those associated with the university? Should he involve himself in non-academic activities outside the university? How far should any such involvement go?

1. Participate in the organisation of activities outside his particular field of interest SD D A SA

16. Be involved in activities outside the institution and away from students.

Table 4.16 (Cont'd.)

Should lecturers be prepared to answer for the university if it receives bad publicity? Are lecturers to be seen as spokesmen for the university?

7. Be prepared to act as a spokesman for the university or faculty. SD D A SA

13. Insist that his status as a staff member be recognised. SD D A SA

Should a lecturer be involved in the following:

28. Participate in the administration of student disciplinary measures. SD D A SA

32. Avoid involvement in administrative matters. SD D A SA

20. Participate in policy-making committees. SD D A SA

10. Avoid involvement in course administration tasks (such as timetabling). SD D A SA

Do you think staff should be encouraged to question current practices, or should this be left to the administrators?

4. Be critical of current institutional practices in teaching, research, and other activities. SD D A SA

Would you accept a position that took you out of teaching and research and consisted of administrative duties only?

24. Refuse promotion that inevitably leads to a purely administrative position. SD D A SA

Preoccupation with Students

How important do you think the teaching activities of a university are? Should a staff member try to understand the students culture?.... should he participate in that culture?.... should he try to influence the development of that culture?

2. Be able to speak to the students at their level and be conversant with their culture. SD D A SA

Table 4.16 (Cont'd.)

21. Encourage students to adopt radical views about religion, politics or morality. SD D A SA

17. Avoid discussion of political and social issues with students. SD D A SA

Should the staff be involved with the students on a personal level in personal matters?....vocational matters?....study matters?

29. Be patient with students who stress their own individuality. SD D A SA

25. Avoid becoming involved with the individual student's personal problems. SD D A SA

8. Know something of the future plans of individual students. SD D A SA

Should the university system be structured in such a way as to produce staff isolation from students. Should students supress any desire they may have to fraternise with staff?

11. Not be disturbed by students while in his office. SD D A SA

33. Treat students as subordinates rather than as equals. SD D A SA

14. Be willing to go to the administration on behalf of the students. SD D A SA

At what stage do you consider students can call themselves scientists?

5. Not encourage students to join professional associations. SD D A SA

Preoccupation with Research

How important do you think are the research activities of a university? Is it essential that a lecturer be an authority in his field?

30. Have considerable ability in carrying out research. SD D A SA

15. Be encouraged to publish reports in recognised journals. SD D A SA

22. Be a well known authority in his field. SD D A SA

Table 4.16 (Cont'd.)

Should his workload be structured to allow him the greater part of his time for research?

3. Be given a sufficiently light student-contact load, so that demanding research projects can be carried out. SD D A SA

12. Avoid the temptation of setting aside most of his time for conducting research SD D A SA

9. Be encouraged to keep up with the latest developments in his field by practical means such as study leave. SD D A SA

Should he be prepared to share his research ventures with his undergraduate students? Should he encourage them to test his ideas?

6. No encourage students to participate in research projects. SD D A SA

34. Confine his lectures to the text, avoiding references to recent research findings in the area. SD D A SA

Do you believe that a staff member should....

18. Be selected on the basis of teaching or administrative ability, rather than ability in research. SD D A SA

26. Consider research opportunity as a privilege and not a right. SD D A SA

Autonomy

What degree of freedom should a lecturer have in developing, running and assessing his courses?

19. Be able to teach and examine in any way he chooses. SD D A SA

23. Be able to select the content matter of courses, free from direction by others in the faculty or university. SD D A SA

Table 4.16 (Cont'd.)

Should a lecturer keep out of the public eye except when he has achieved something that adds to the university's prestige? Should he make criticisms of the university or expose facts about himself that may discredit the university?

31. Strive to maintain a good public image of the university. SD D A SA

Should a lecturer take steps to monitor the effectiveness of his lectures? Should he take note of student opinions and surveys relating to his lecturing?

35. Be prepared to assess the effectiveness of his teaching techniques. SD D A SA

27. Act on the comments of students about courses. SD D A SA

The three forms of the questionnaire are described below.

Form I: Staff questionnaire was distinguished in four ways (See Appendix I)

(1) Frontispiece: The introduction for staff differed from the introduction for students.

(2) Part A: Information required included name, age, and length of experience in tertiary teaching. Spaces were provided for the recording of Position, Highest Physics Qualification, Number of Physics Qualifications and Number of Other Qualifications.

(3) Part B (SGO) asked the staff members to indicate what perception a student in the Faculty should have of the goals and activities of a University. Results of staff answers to the FLEX scale were not used.

(4) Part C (SRO) asked the staff member to respond to the attitude expressed.

Form II: Student Questionnaire (First Administration) had the following characteristics:-

(1) Frontispiece: The introduction was specifically aimed at encouraging student participation.

(2) Part A Information requested included name, ID number (for cross-check), course, age, sex, scholarship, occupation of Head of Family, planned further studies, and residence, and involved space for recording Higher School Certificate Aggregate score, HSC physics score, First year Physics score and Second year Physics score.

(3) Part B (SGO) asked the student to respond to the statements.

(4) Part C (SRO) asked the student to indicate the desirability of each statement of a lecturer.

(5) Part D Was a collection of six questions regarding the significance of others in the students attitudes to tertiary education. These were used to test an assumption (see Chapter 6) and in a published report (See Appendix III)

Form III: Student Questionnaire (Second Administration) was identical to Form II except that Part A only showed the students code number in the study.

Copies of letters accompanying each administration can be found in Appendix I.

To this point, the definition of Student Goal Orientation and Staff Role Orientation have been described and the development of instruments to measure them has been discussed, from the initial selection, testing and evaluation of items to the preparation of the final forms. The remaining issue to be discussed is the measurement of the interim variable - Achievement.

4.5. The Measurement of Achievement

In Chapters 2 and 3 the point has already been expressed that the most meaningful measure of achievement in this type of study is the measure prepared, administered, and scored by each lecturer in the study without interference from the researcher.

An example examination paper is presented in Appendix II, with identifying information removed. The express concern is to preserve the anonymity of the lecturers participating in this study.

The examination papers were extended answer type, with about three major questions broken into many parts. An analysis of the paper by the staff who set them and by the writer, failed to show any distinct differences in the emphasis of any one type of question. In terms of Blooms (1971) Cognitive Taxonomy, the levels represented were commonly Knowledge 10%, Comprehension 30%, Application 50%, Analysis and higher 10%. There were no major deviations from the distribution. The Achievement tests were administered at either a Mid-year examination or a Final examination. The results of these could only be used together if the students did not change significantly in their orientations over a semester. The results of the test of this requirement are discussed in Chapter 6.

The question of validity or reliability of those papers does not arise as these are partly a function of the interaction between the lecturer and the student, and hence are an integral part of the process being investigated. Indeed, efforts to improve reliability may influence the interactive factor (component III in Figure 2.10).

The quality of the measures of the independent variables, the SGO and SRO scales, however, must be substantiated. This is the function of the Chapter that follows.

CHAPTER 5

QUALITY OF INSTRUMENTS

Without demonstrating that the instruments actually work and work well, all the preparation and theorising of the former chapters is without purpose, and all the research and analysis of the following chapters would be without foundation. It is an aspect of research that often receives little attention, particularly that most crucial aspect of validity, partly because of the difficulty of obtaining evidence of quality, and partly because of the assumed quality assured by operational definitions. No new instrument can be incorporated in any research, scientific or educational, without an evaluation of its properties.

Part A of the questionnaires obtained objective information about the student - age, scholarship, residence etc. There could be little doubt of the accuracy of response to these items, except, perhaps in regard to 'occupation of the head of the household.' In fact, this item was sufficiently supported by examples to ensure that no difficulty was encountered in answering it.

Evidence of quality is far less easy to obtain for Part B (SGO) and Part C (SRO), and it is with these sections that the remainder of this chapter shall deal.

Questionnaires and tests can be evaluated on four distinct but interrelated criteria, their validity, reliability, efficiency and reactivity. The relatedness of these criteria imposes a hierarchy of dependence which oddly is roughly the inverse of the hierarchy of importance. For example, the most crucial requirement, validity, is restricted by the lesser requirement, reliability. An unreliable test cannot be valid. A discussion of the hierarchy is really only of philosophical importance, as, if a test fails to satisfy any of the criteria, it fails as a test.

Each of these four criteria can be subdivided into parts. The following discussion considers each criterion in turn, starting with reactivity and working through to validity.

The sample used in this exercise is described fully in Chapter 6, Section 1., and the reader is directed to that reference for any detail required. Reference is made to a first administration and a second administration. These were four months apart, the first was chiefly administered in class, the second by mail. The questionnaires were administered to Physics students in first, second and third year, and to the staff of the Physics Department.

5.1. Reactivity

The reactivity of a test can be viewed in a number of ways. These are: the effect of the test form and content on the students willingness to respond, the effect of the test on the function being measured, the effect of the test on other functions. A good 'test' must be minimally reactive (have little effect) in all cases.

5.1.1. Reactivity and Willingness to Respond

The test form and content must be such that the respondent is not biased against the test. The test may appear devious and the respondent may be suspicious of its stated purpose. It may be complex, and the student may become confused and angry.

It may be searching or suggestive, and the student may react to the 'intrusion into his privacy' or may become embarrassed. With mature, test sophisticated, and (hopefully) intelligent respondents, such as are used in this study, the danger of reaction is greater. They are less likely to take the test on faith, but require an explanation of purpose and assurances of an anonymity. The frontispiece of the first administration questionnaire and the information sheet enclosed with the second administration questionnaire attempted to provide such assurances in order to obtain the students co-operation and to decrease undesirable reactive effects.

Reaction may be indicated by an active response (written response to comment) or a passive response (refusal to respond to item).

Test Reactivity of Students

Some evidence of the success of these assurances can be seen in the response percentage of the students. In the first administration only one student in the captive audiences (totalling 227 students) refused to anser the questionnaire. The eventual sample of respondents, after follow-up, was 98% of the target population of physics students.

Their willingness to respond was again reflected in the second administration, where as many as 82% of the population approached responded - a high figure for a mail questionnaire, especially considering that it was the second administration, and that it was administered just before final examinations!

Written reactions to the questionnaire as a whole range in content.

A few criticisms of layout (regarding difficulties for left handed respondents), a protest that 'the questionnaire was an invasion of privacy', and two general criticisms of the item content (repetitive or 'rubbish') comprised the total written comments on the questionnaire as a whole. No doubt some others reacted along similar lines, but refrained from putting it in writing. It appears that overall, the test evoked very little unfavourable reaction from the students.

Item Reactivity of Students

The parallel to test non-response is item non-response - a form of passive reaction to an item. The mean item non-response varied between Part B and Part C, and for Part C, between administrations. Part B (both administrations) had a mean non-response of .7%, Part C (first administration) was almost twice that (1.2%) and Part C (second administration) three times as large (2.3%). It must be kept in mind that non-response also arises from no opinion and these figures could simply reflect this. Hence, only items with inordinately high non-response and/or comments have been classed as reactive (non-response greater than 2%).

Evidence of reactivity can be gleaned from comments that the students make about the items. Records were made of every comment made by respondents. A total of only 177 comments were made, representing less than half a percent of the 38,990 items presented over the two administration. The nature of the item comments bears consideration. More than half the comments simply repeated the given response (59%), as few as 13% of the comments indicated uncertainty as to the meaning of items, 12% were simply general comments prompted by the content of the item, 6% were constructively critical, and 6% were destructively critical (leaving 4% unclassified). In addition to this, 55% of the 177 comments were made by only 7 students (2% of the sample), remaining 45% by 41 students (14% of the sample). Simply reversing this, 84% of the student population considered it unnecessary to make comment and 98% considered it unnecessary to make any more than a few comments. These figures suggest that the items are quire unreactive.

Certain specific items require investigation because of their apparent high reactivity - based on non-response and comment frequencies.

From Part B, items 11, 16, 26, 28 and 35 drew considerable comment (more than 4% of the comments) and items 28 and 35 showed high non-response rates (more than 1%). Table 5.1 shows the items and the number of comments classified as above.

Once again, these reflect little negative reaction. The reactivity of these items shall be considered again when items are evaluated in a later section.

TABLE 5.1

Items with high reactivity - Part B

Item	Explanation	Confusion	General Comment	Constructive Criticism	Destructive Criticism	% of comment for Part B	Non-response
11. A university education should train students to become adept in a narrow field.				4	1	6%	
16. The working year is too short at this university.	3	1	2			7%	
26. Formal examinations should not be used at universities.	1		4			6%	
28. These are the best years of your life and should not be wasted on study.	3		1		3	8%	High
35. You would do better if you held the same views as your lecturers.	4	2			4	11%	High
Total	11	3	7	4	8	38%	

From Part C items 13, 17, and 24 evoked considerable comment (more than 4% of all the comments for Part C), and items 1, 5, 13, 22, 24, 26, and 31 showed relatively high non-response rates (more than 2%). Table 5.2 shows these items and the numbers of comments classified as above.

TABLE 5.2

Items with high reactivity - Part C

	Item	Explanation	Confusion	General Comment	Constructive Criticism	Destructive Criticism	% of comment for Part C	Non-response
13.	Insist that his status as a staff member be recognized.		3	3			7%	High
17.	Avoid discussion of political students.	8	2			1	12%	
24.	Refuse promotion that inevitably leads to a purely administrative position.	8				3	12%	High
5.	Not encourage students to join professional associations.	1					1%	High
22.	Be a well known authority in his field.	4					5%	High
26.	Consider research opportunity as a privilege and not a right.	1					1%	High
31.	Strive to maintain a good public image of the university	1	1				2%	High
	Total	23	6	6		4	40%	

In Table 5.1 and Table 5.2 certain items have been identified as highly reactive (more than 4% of the comments), but is the number of comments given to each a true indication of reactivity?

Given that there were 177 comments overall for the 70 items in the test, one can show how the comments would be distributed across the items randomly. This distribution, and the actual distribution are given in Table 5.3. (Derived using the Poisson Distribution (large η, small π).

TABLE 5.3

Actual and Expected Frequency of Comments

Number of Comments	0	1	2	3	4	5	6	7	8	9	10	11
Expected number of items	4	12	17	16	11	6	3	1	0	0	0	0
Actual number of items	17	7	15	13	10	2	2	1	0	0	1	2

Comparing these distributions using the Kolmogorov-Schmirnov one sample test gives a D value of .186 which has a probability which fails to meet the required .05 level of significance. In other words, the distribution of comments differ significantly from random. However, this deviation is greatest at the low point of the scale, so it could be argued that the distribution is 'better' than random, and that only the three items at the top of the distribution are really abnormally reactive. These items, number B35, C17 and C24 have no particular characteristics in common.

In conclusion, the evidence suggests that the questionnaire as a whole is unreactive in terms of the students willingness to respond, and that no items show marked reactivity (though a few, some reactivity) in relation to the students willingness or ability to respond as intended. Overall, it does not seem that it was viewed as an intrusion to privacy, nor as an imposition, nor as incompetent, nor did it create confusion or evoke suspicion.

A comparison between administrations of the non-response showed that the passive reactivity for Part C of the second administration was very high. This could indicate fatigue, genuine lack of opinion or lack of interest. A comparison of the active reactivity along similar lines shows a drop in comment (32 cf 47) in Part C - suggesting that the previous commenters may have become non-respondents the second time around.

TABLE 5.4

Passive reactivity

	First Administration	Second Administration (82% of first)	Total
Part B	48	40 (40)	88
Part C	57	32 (46.7)	89
Total	105	72	177

The figures in brackets show expected number based on first administration frequency.

Staff

The approach of staff members to the questionnaire was quite different, and requires separate study. The administration took a more personal form, in that the lecturers were approached individually and followed up individually. This offered opportunity for the researcher to give a fuller explanation of purpose and to explain questions when difficulties arose, than was available to the students. Whether the difference in approach would affect the factors being determined will be discussed in the next section.

Test reactivity of Staff

The lecturers reactions varied from eagerness, through apathy, to strong opposition. The opposition reaction was evident before the lecturers had seen the questionnaires, and reflected a general attitude to educational questionnaires and educational research. It must be said in their defence that their initial opposition is quite understandable, considering some of the educational research they had previously encountered. After differing amounts of cajoling, all but one staff member provided the information requested. The important point to be made here is that this group of lecturers reaction is general to all educational questionnaires, not just this one. How this affects other properties shall be dealt with later. The remaining lecturers promptly returned the questionnaires, accompanied by oral, and in three cases written, comments.

General comments indicated some difficulty. The lecturers as a group were far more 'careful' or cautious in answering the questions, and tended to read far more into the questions than was intended. The request to 'answer as quickly as possible' seems in these cases to have gone unheeded. The reaction of one lecturer to the questionnaire is shown in Figure 5.1. This represents the strongest written comment on the questionnaire, and each comment is completely definsible from the researchers point of view. (Item 1 is dealt with in this chapter, Item 2 in the previous chapter, item 3 in chapter 6).

Item reactivity of Staff

Most verbal comments received suggested that many lecturers would prefer to assist the researcher in item writing techniques than to answer the items. A breakdown of the 37 written comments (with the equivalent student percentages and parenthesis) is as follows: explanatory comment 52% (59%), enquiry comments 32% (13%), general comments 5% (12%), constructive criticism 8% (5%), destructive criticism 3% (6%). These percentages must be treated with great caution because of the very small number of staff involved. The percentage of items drawing comments is expectedly higher with the staff than with the students (1.8% compared with .5%) but is still quite low. Only three staff members were moved to comment, a lower percentage than the students (10% - 17%) but they had only one opportunity to do so, and more opportunity to communicate comments orally.

With so few lecturers making comments, an item by item analysis is hardly possible. Items drawing comments from two or three lecturers are, Part B 12, 15, 18, 31,and Part C, 12, and 19.

Non-response rates varied - most items were unaffected, but some had quite high levels, notably items 19, 23, 27, 31, and 35 from Part B, and item 18 from Part C. All the Part B items listed are from the 'student flexibility' scale, the items of which are not in any way answerable by staff. Only one item,then, item 18 from Part C, could be said to have a high non-response rate.

1. I had some genuine difficulty with your questionnaire. Many of the questions were inadequately framed, a high proportion were ambiguous. I have usually written in comments in such cases.
2. Your four categories seem to me inadequate. What I think NA, e.g. someone else may call A, etc. So how you can hope to correlate this I do not know.
3. The general tone of the questions seems to reflect the views of student radicals, Lots Wife* and had the effect of putting me very much on the defensive. I think many of my colleagues may turn out to be totally unsympathetic to this survey.
4. I would be very unhappy about drawing any general conclusions from this. Since we as a Physics department have been brought in, I think it only proper we should see any written documents relating to this before any circulation or publication.
5. You folk in Education may know more about measurement in 'social psychology' but I don't believe we're doing everything badly.

Figure 5.1

Comments from Staff Member

* the students' newspaper

General Comments

Another problem related to this form of reactivity is the faking of answers, either to please or annoy the researcher. This can be reduced by obscuring the real purpose and structure of the questionnaire. There is no way of estimating such an effect - one can only try to limit it.

In summary, the lecturers showed little reaction specific to this questionnaire, supporting the earlier finding illustrated by the students responses.

5.1.2. Reactivity of Test on Function Measures (turbidity)

One of the fundamental of physics is known as Heisenberg's Uncertainty Principle. In layman's terms it simply says that you cannot measure a property of anything without changing that property. For example, to measure the kinetic energy of a bullet, some or all the energy must be changed to a different, measurable form. The kinetic energy at the moment of interest can be measured exactly, but in doing so the kinetic energy is changed. The same applies to psychological tests, achievement tests, and sociological questionnaires. They may measure the property of interest precisely, but they will interact with that property to change it. Further testings will thus register changes that might not have otherwise occurred. These are confounded of course, with test wiseness, 'real' property changes and test unreliability, and are by their nature impossible to isolate. In social psychology, as in physics, after accepting that this kind of reactivity is inevitable the researcher must strive to minimise the effect.

This can be done a number of ways. One is by attempting to disguise the test, so that at least the subject is not consciously aware of what is being measured. The test is still part of the respondents experience and may have strong subliminal effects, especially if the respondent is suspicious. Such a reaction, as mentioned earlier, may distort the measure being taken, (not only future ones), and so it is to be avoided. Another is to try to keep items neutral - avoid strong or emotive words - so that the subjects response is simply a reflection of his true feelings, not a reaction to implications. This may be impossible to achieve, as the behaviours may not have neutral expression. The best approximation to neutrality can probably be achieved by using an equal number of positive and negative items. The questionnaire may still be perceived as biased, as can be seen in the comment made by lecturer 14 (Figure 5.1). Further to this, one cannot be sure that the positive and negative items carry equal weight, and furthermore, in summative scales, one cannot be sure that the negative items are factorially the same as the positive items. A check of this feature can be made by considering positive items and negative item inter-correlations. These should be reasonably large and negative. (They must be significantly larger in magnitude than zero, but are unlikely to be higher than the lowest realiability index for each item pair, which provides an upper limit to error variance. Higher correlations can occur by chance.) Table 5.5 shows the item characteristics in this regard for each scale.

It is quite clear from these results that in all scales but the last, the positive and negative items balanced each other according to plan. The finding for the last scale may reflect its special significance to staff only.

Table 5.5

Intra-scale Item Intercorrelations

Scale	Number of Items	Number of -VE Items	Number of +VE & -VE Item Pairs	Number of Item Pairs with r<o (ρ≤ 0.01)	Prob.of Result.
1. VOL	10	5	25	25	<0001
2. BRE	10	5	25	24	<0001
3. MOT	10	5	25	19	<01
4. FLEX	5	2	6	6	<02
5. INST	10	5	25	19	<01
6. STD	10	5	25	21	<001
7. RES	10	5	25	19	<01
8. AUT	5	3	6	4	<05

The effects of the questionnaire need not be of great importance to the current research if the number of conditions are met. The first is that the measure is made after the factors being measured have had their main effect. Chapter 3 hypothesises that the interaction of interest begins in the lectures and ends in the examination. Thus, to reduce the effect, the administration should (and did) take place as close as possible to the examination. (Measurement immediately after the examination would be distorted by the experience of the exam, and the students would be hard to approach.)

The method of administration was more individual for staff than for students, and it is possible that this could have had an effect on the factors being measured.

In all communications the researcher scrupulously avoided all discussion of the content of the questionnaires, restricting comments to the form of answering, and to the value and use of education questionnaires in general. Whenever possible, questions were answered by drawing the attention of the staff member to the relevant passage in the frontispiece.

In any measurement, the aim of the researcher is to reduce the interaction effects to a minimum. The level of accuracy one must strive to exceed is the error of measurement introduced by other factors, such as reliability. This point is easily ascertained when experiments are repeatable with identical samples, as in the physical sciences, but it is impossible to assess in the social sciences. There is no way of estimating the size of this undesirable interaction for this questionnaire, but there are ways of reducing it and its effects to a minimum, related to the design of the questionnaire scales, and to the experimental design. Both have been considered in this study, so that it can be said that this interaction and its effects have been kept to a minimum.

5.1.3. Reactivity of Tests and other Variables (Disturbance)

The previous section dealt with the possibility of the instrument entering the measurement situation and effecting the measurement. This section deals with the instruments effects on the actual experiment. The questionnaire stimulates the student to consider his motives for attending university and prompts him to indicate the desirable qualities of a lecturer. Either part may directly effect his performance (the outcome of the experiments); the former may motivate or discourage the student upon introspection of his goals, the latter may lead to the valuation of his lecturers, possibly creating dislike or distrust where non previously existed. This awakened self awareness or awareness of others may reverse trends previously existing, confounding results considerably.

No evidence of this is available. No comments indicated such an effect. There are ways of minimising this kind of reactivity - disguising the questionnaire, confounding the questionnaire (using it to measure a number of different factors simultaneously), or by breaking down a property into its constituent parts and reconstructing it afterwards. The last method seems to be most desirable. (It incorporates the first two.) One can ask about a person's feeling towards sandwiches, flies, rivers, trees, etc., to measure enjoyment of picnics, without directly asking them about picnics. This creates difficulties regarding weighting,(is the dislike of flies more important than the like of sandwiches?) and of conceptual completeness (is a picnic the sum of sand, flies, rivers, etc.? Are other parts present? Is the sum greater than its parts?) These questions relate to the realness of labels given to various combinations of factors - and this comes back to the use of the operational definitions discussed in chapter 4. It seems unlikely that a student on completion of his questionnaire would be able to deduce that he is a dilletante or a scholar.

It is possible that the questionnaire may change the students behaviour, but it is more likely that this change would be in intensity rather than in direction.

5.1.4. Reactivity Summary

It has been shown that the questionnaire is quite unreactive, and where concrete evidence is unavailable, that it is unlikely to be reactive. There is a minor blemish, the poor performance of three items, but overall the results are acceptable.

5.2. Efficiency

One can draw many parallels between the desirable qualities of machines and of questionnaires. In the first section of this chapter, reactivity of questionnaires was considered. There is a machine parallel to this - a machine must be constructed of parts that do not chemically react with the raw materials or the product of the process. Another quality of a machine usually sought, is efficiency. It is inefficient if it does not use as much of the raw material as possible, and if it has parts that do not contribute to the process. In other words, all parts should contribute to the process. The raw material of questionnaires are the student's responses, and they must not be wasted. They are optimally useful when they cover the whole response range, or in other words when the items, and the scales they produce, are sensitive. The parts of a questionnaire contributing to the process are the items. Any item that makes no contribution, or worse, a negative contribution to its scale reduces efficiency. Such items do not discriminate. In this section item and scale sensitivity, and item discrimination shall be considered.

5.2.1. Sensitivity

It is well to realise that any test property may be dependent on the sample with which it was determined. Thus, while the test may be unreactive to physics students, it may well be highly reactive to english students. To assess the generalisability of the parameters, one must administer the test to a completely different sample. This gives rise to an index of reliability known as *transferability* that shall be dealt with in section 3. This acts as a cautionary note that the findings of this chapter may be specific to a sample of physics students. The sensitivity of a questionnaire may also be dependent on sub-samples *within* the group. Indeed it is expected that the *sensitivity* will drop as the groups become more homogeneous, as hypothesised.

Sensitivity is simply a measure of the use made of a scale. An ammeter with a full scale deflection of 100 amperes is quite insensitive to small currents that will never exceed 1 ampere. The most sensitive meter to use is one which will give a full scale deflection for the greatest expected current. Similarly, in a questionnaire item or scale, if the whole choice set or possible scale value set is not being used, then either the sample is relatively homogeneous, or the item or scale is insensitive.

Scales that are formed by the summation of items cannot be fully sensitive if any of the items are insensitive. In fact, the maximum sensitivity of a scale can be seen to be the sum of the sensitivities of each item.

Thus, if we have;

for N items

a items using whole scale (4 choices)

b items using three quarters scale (3 choices)

c items using half scale (2 choices)

and the remaining items using a quarter scale (1 choice)

then

$$\text{maximum score range possible} = 4a + 3b + 2c + N - (a + b + c) - N$$

$$= 3a + 2b + c$$

It is therefore instructive to study item sensitivity first, then scale sensitivity, using the results of the item analysis and the above formula as a base for comparison. It is possible for a summated scale to have better properties than the parts that compose it - but this is not the case for sensitivity.

Item Sensitivity

Item sensitivity can simply be reported by the numbers of items falling into each of the categories described above. Table 5.6 shows that the great majority of items are highly sensitive (full range used). Only 3 of the 70 items show a slight lack of sensitivity (three quarter scale used) in the first administration, and 10 items, in the second*. Items showing consistent lack of sensitivity are items 8 and 24 from part B, and item 9 from part C. Other items showing lack are, from part B, items 2, 10, and 25, and items 2, 6, and 11 from part C. These results are obtained from the whole student group. One would expect the sensitivity to drop for years taken separately, the drop being greatest in the later years (because of greater homogeneity).

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* This is consistent with the increased non-response in the second administration.

Table 5.6

Item sensitivity for each scale

Administration	Scale	Number of items	Use made of whole scale	Use made of 3/4 scale	Items lacking full sensitivity (number)	Maximum possible scale range
First	1	10	9	1	24	29
	2	10	9	1	8	29
	3	10	10			30
	4	5	5			15
	5	10	10			30
	6	10	10			30
	7	10	9	1	9	29
	8	5	5			15
Second	1	10	8	2	10,24	28
	2	10	7	3	2,8,25	27
	3	10	10			30
	4	5	5			15
	5	10	10			30
	6	10	8	2	2,11	28
	7	10	8	2	6,9	28
	8	5	4	1	35	14

Table 5.7

Item Sensitivity and Year of Study

	First Administration		Second Administration	
	Part B	Part C	Part B	Part C
Whole group	8,24	9	2,8,10,24, 25	2,6,9,11, 35
First year	1,8,24	1,9		
Second year	2,3,4,8,9,10, 24,25,29,32	3,8,9,11,14,15, 16,27,29,35		
Third year	1,2,3,4,8,10, 6,19,21,23,24, 25,26,27,29,30, 32	1,2,4,5,6,7,9, 11,12,13,16,27, 29,33,34,35		

Items using less than the whole scale

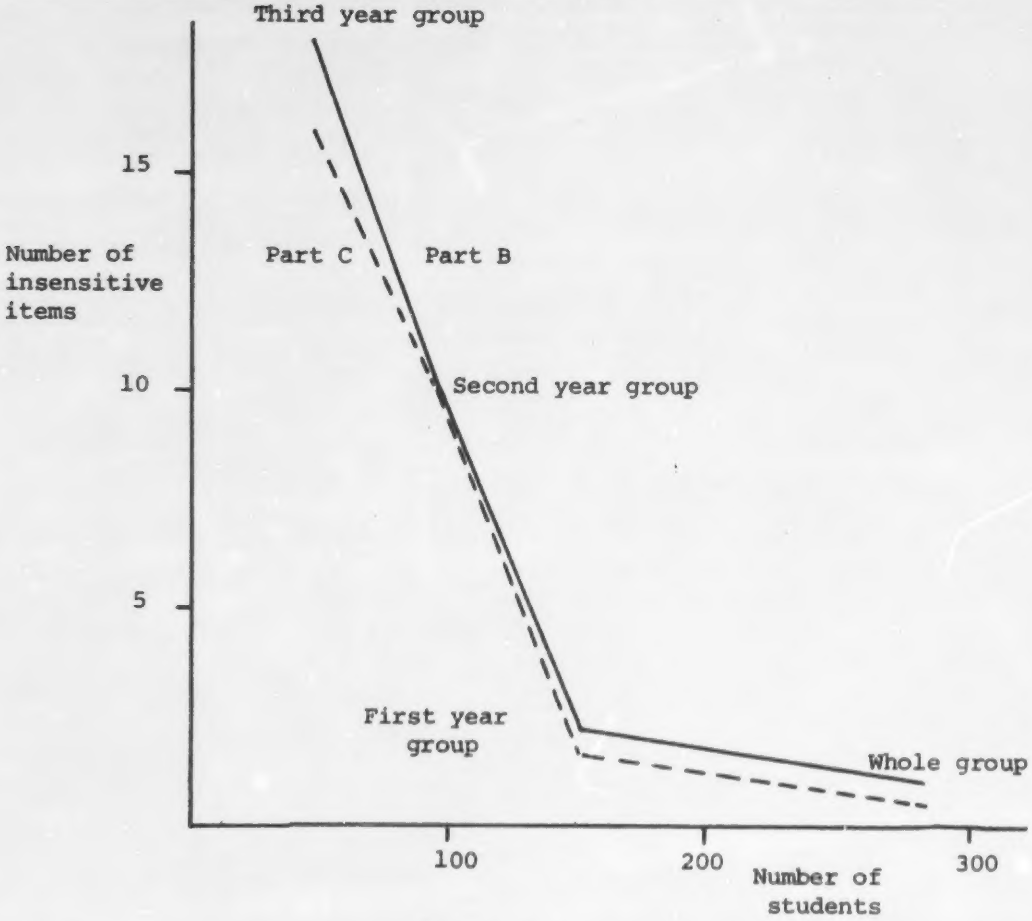

Figure 5.2

Change in sensitivity First Administration

Figure 5.2 shows that sensitivity does depend on sample chosen, and that it drops for later years, suggesting greater homogeneity. Table 5.7 also implies that the students became more homogeneous as a whole as the year progresses, or that the devient students did not respond to the questionnaire the second time. This shall be followed up in chapter 7. The high item sensitivity permits a large range of scores for the scales, as indicated in Table 5.8 (last column). The actual scale sensitivity shall now be considered.

Table 5.8

Scale sensitivity - possible and actual range

	Scale	Possible Range	Highest Score	Lowest Score	Actual Range	Sensitivity as % of possible Range
First Administration	1	29	36	20	16	55%
	2	29	37	17	20	69%
	3	30	37	11	26	87%
	4	15	18	6	12	80%
	5	30	30	17	13	43%
	6	30	37	15	22	73%
	7	29	34	17	17	60%
	8	15	18	8	10	67%
Second Administration	1	28	37	20	17	61%
	2	27	37	20	17	63%
	3	30	35	16	19	63%
	4	15	17	7	10	67%
	5	30	30	16	14	47%
	6	28	38	20	18	64%
	7	28	39	16	23	82%
	8	14	18	8	10	71%

Scale sensitivity

Table 5.8 shows the range observed for the whole student sample compared to the possible range. Sensitivity can then be calculated as a percentage of the possible range. This information is given in the last column in Table 5.8. From this information it can be seen that scales 3 and 4 appear to be the most sensitive, and scale 5 the least sensitive. The low figures obtained must be interpreted as indicating that the respondents choosing extremes on some items of the scale are not consistently choosing extremes on all items.

This is to be expected to some extent (as each item in a scale is designed to test a different facit of the same factor,) but there should be some individuals choosing extremes more consistently.

Another approach to the same problem can be made by considering the standard deviations of the scales. It is proposed that the underlying distribution of the factors (scales) is normal*, mean 25, and standard deviation approximately 1/7th of the range, i.e. 4.29, or 2.14 for the 5 item scale. The standard deviations obtained can be compared using an F test.

Table 5.9

Scale Sensitivity

		Scale							
		1	2	3	4	5	6	7	8
First Administration	SD	2.77	3.21	3.47	2.02	2.48	2.88	2.82	1.60
	F	1.55	1.34	1.24	1.06	1.73	1.49	1.52	1.34
	P	<01	ns	ns	ns	<01	<05	<05	ns
Second Administration	SD	2.52	3.07	3.43	2.04	2.35	3.01	2.97	1.46
	F	1.70	1.40	1.25	0.05	1.82	1.43	1.40	1.47
	P	<01	<05	ns	ns	<01	<05	<05	<05

---

*This is shown to be the case in section 5 of this chapter.

It can be seen from Table 5.9 that in each case the expected standard deviation is larger than the observed standard deviation, scales 3 and 4 again are classed as sensitive, scales 2 and 8 as moderately sensitive, and scales 1 and 5 poorly sensitive. These results are precisely consistent with the findings based purely on range.

As this questionnaire was designed to be usable with any group of students and as no mention of physics was made for that reason, it could be expected that the physics group was indeed a select group. For this reason one should not be too disturbed by the apparent insensitivity of the scales.

5.2.2. Item Discrimination

In a summative scale, each item must make a positive contribution to the total. Items making no contribution, or worse, a negative one are clearly inefficient. In fact, those making a negative contribution are clearly invalid, (non discriminatory) a concept that shall be discussed later in this chapter. This section shall deal with the items which are 'valid but inefficient members of the scale'.

The same indices are used to check validity and efficiency, the most common being item - scale correlations and Edwards t-score. For a small scale, item-correlations will be artificially inflated, since the item is a major contributor to the total. In fact, if there are N items in a scale, a correlation of $1/\sqrt{N}$ can be expected simply because the item contributes to the total. If one has a 10 item scale, this value is .31. To overcome this difficulty, item-scale correlation must be calculated using as the scale criterion the total of all the other items in the scale. An item with correlations not significantly different from zero can then be called inefficient, with a correlation significantly negative, invalid, significantly positive valid and efficient.

Edwards t score is calculated by splitting the sample of students into quartiles on each scale total, and then comparing the mean score of the upper and lower quartile groups on each item by the standard Students - t test. A t value of zero indicates no difference, and an inefficient item. A negative t value indicates invalidity. A positive, significant t value indicates a valid, efficient item. In many ways Edwards - t test and item - scale correlation are identical. They differ, however, in that the correlation is calculated over the whole group (not half), is less susceptible to scaling inaccuracies (discussed in Chapter 4), and provides a more meaningful extension - the percentage common variance. In each case reported below, where the item failed to meet the requirement specified above for correlation, it also failed those for the Edwards - t test, and vice versa. Thus only the correlation result shall be reported.

Item discrimination should be determined over the whole physics student sample, as smaller samples render correlations inaccurate. No items showed significant negative (invalid) correlation with their partial scale totals. However, three items consistently showed correlations not significantly different from zero, and must be judged inefficient. These items were numbers 9 and 25 from Part B, and number 16 from Part C. A careful distinction must be drawn here between statistical and item parameter significance. An item may correlate .3 with its scale total - statistically significant result for large groups - but this indicates common variance item-scale of as little as 9%.

Table 5.10

Distribution of item-part scale correlations

		Cumulative Frequency Item - semi scale correlations					
	Scale	>.6 36%	<.6 36%	<.5 25%	<.4 16%	<.3 9%	Not sig. diff. from O.
First Administration	1	10	9	8	5	2	0
	2	10	8	4	1	1	1
	3	10	6	4	2	2	1
	4	5	4	1	0	0	0
	5	10	10	8	5	3	1
	6	10	9	5	2	2	0
	7	10	10	9	3	0	0
	8	5	3	1	1	1	0
Second Administration	1	10	10	10	6	1	0
	2	10	9	6	4	1	1
	3	10	6	4	1	1	1
	4	5	3	1	1	0	1
	5	10	9	7	5	2	1
	6	10	8	3	2	0	0
	7	10	10	5	1	0	0
	8	5	3	1	1	1	1

A more critical yard stick by which efficiency can be judged, is the minimal expected contribution an item should make. Since, in the large scales, each item represents one tenth of the scale, it can be at least expected to contribute 10% to the scale variance. (20% for the 5 item scales). This will naturally consist of four parts - common variance, (common to all other items), semi-unique variance (common to some other item), error variance, and unique variance (not in any other item). If the item has been omitted from the evaluation of the scale total criterion, then the last of these is removed.

Thus the percentage reported represents common, semi common, and error variances only.

Contrary to current beliefs expressed in popular measurement tests a very high item-scale correlation is not always desirable. Efficiency also requires that each component (of a machine or questionnaire) makes a unique contribution to the process, and doesn't just repeat another's function. Very high correlations would imply that all the items were performing identical tasks, and that one could safely replace the long, inefficient test by a single, efficient item. It is the hope of the researcher, and indeed, a necessary requirement, that each item make a unique contribution - for this reason very high discrimination indices are not sought, but moderate correlations, greater than.3 but not large, are desired.

Eleven of the seventy items failed this criterion in the first administration, and six in the second (inclusive of items showing non significant relationships to this scale total). Items that failed both testings are from Part B items 7, 9, and 25, and from Part C items 1, and 27, a total of 5 items.

Part of the error variance will be due to an ansering set (an approach to answering). This could be indicated by a correlation with a total questionnaire score greater in magnitude than the correlation of the item with its scale. Ten items, six in Part B and four in Part C failed this criterion.

5.2.3. Efficiency Summary

The questionnaire met the requirements of efficiency at item level and as a whole. The questionnaire appeared least sensitive on one scale on which the bulk of the respondents - the students - could not validly respond.

The following two sections - reliability and validity - do not deal individually with items, but consider scales as a whole. Before embarking on a study of these properties, an assessment of the information from the last two sections would be valuable. Table 5.11 presents this information.

Table 5.11

Summary of performance of items

	Part B		Part C	
	First Admin.	Second Admin.	First Admin.	Second Admin.
Non-response	28,35			
Comment	11,16,26, 28,35	included	1,5,13,22, 24,26,31	included
Sensitivity	8,24	2,8,10,24, 25	9	2,5,9,11
Discrimination: Zero	9,25	9,25	16	27
Discrimination:10% constituted variance	1,7,9,18, 25	7,9,25	1,5,16,21, 22,27	1,4,27

Considering item by item, one finds a number of items that stand out as consistently poor. These are, from Part B item 9 (six occasions), item 25 (five occasions), (the others occur only once or twice), and from Part C, item 5 (five occasions), (the others occur three times or less).

The decision to exclude these items from the analysis, not the questionnaire, was taken after the first administration and the correctness of this decision was reflected in the second administration. Exclusion of these items from their scales will change the properties of the scales*, and in the following sections, figures reported shall include those for the revised scales. (Changes will occur in scales 2, 3 and 6, they could improve or weaken reliability and validity.)

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* The reader may be alarmed at this revision of the questionnaires. A number of points should be made clear:

1. The actual questionnaires were not changed, simply the scoring of them.
2. Items 'deleted' were demonstrably weak in both administrations. Their exclusion was therefore confirmed by replication.
3. The decision to delete items was based on data not directly related to reliability or validity. Such a procedure would be quite unacceptable. Cureton (1950) makes this point very strongly:

> When a validity coefficient is computed from the same data used in making an item analysis, this coefficient cannot be interpreted uncritically. And, contrary to many statements in the literature, it cannot be interpreted 'with caution' either. There is one clear interpretation for all such validity coefficients. This interpretation is-
>
> 'Baloney!' (p.273)

To dispel any fears of distortion by the revision of the questionnaires, the remaining sections will report results for both the original and the revised scales.

5.3. Reliability

Extending the machine analogy introduced in the previous section further, another important property of a machine is its reliability. Ideally, it must be able to operate consistently in different situations, with different operators, at different items, and sometimes even with different raw materials or fuels. The same parallel can be drawn with questionnaires - they must produce equivalent results if used in different surroundings, administered by different persons, to different samples of students, and at different times. Just as with a machine, not all these qualities may be necessary - it is not necessary for the average car to be as reliable with grain alcohol as a fuel as it is with petrol, as it shall probably never be fuelled that way, and was not designed to be. Similarly, not every test needs to be equally reliable with different groups of students - it may have been specifically designed to 'run on' physics students. Before discussing reliability one must therefore describe the expected limits of the test, and this shall be done with each section.

> .....*personality and motivation tests* should not be judged by the standards of reliability customary in traditional, long, and simple *ability* tests, but by the value current in their peers.
>
> (Cattell and Warburton, 1967, p.48).

5.3.1. The Measurement of Reliability

The reliability of a test can be measured accurately one way - by test - retest experiments. Many writers add to this parallel forms and split-halves 'reliability' but they shall not be included here. Some justification for this decision is necessary. Parallel forms and split-halves 'reliability' (an approximation of parallel forms reliability) are based on the premise that a reliable test must be internally consistent.

(This word may be the cause of the trouble, in that it has two meanings, viz: 'compatible' and 'constant' - the latter being the correct synonym for reliable, the former, more rightly, suggests validity). The real meaning of parallel forms reliability can be deduced from the process of its determination.

Consider the whole field of behaviours that could indicate the existence of attribute X, some of which are strong indicators, and some weak. A test, A, is formed by sampling from this field, and a parallel test, test B, by another sample.

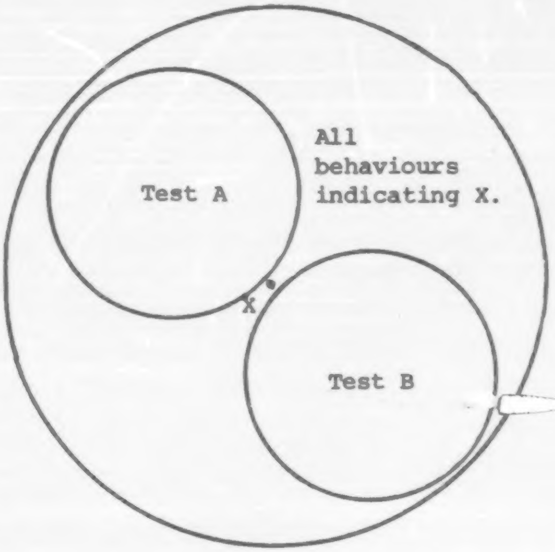

Figure 5.3

Venn Diagram of Item Selection

The two tests are administered to a group in situations where every effort is made to control disturbing influences. The results are then correlated, and this is called the 'index of reliability'. But is it really? Looking at the same process, but asking different questions, leads to a different interpretation. The sample of behaviours in A may happen to be a set of behaviours only remotely indicating X.

One cannot be sure of the fidelity of the set as a measure of X. It is unlikely, however, that one would choose two remote sets measuring X, and even more unlikely that they would be highly related to each other through some other variable than X. Hence, a high correlation between the results of tests A and B is an indicator of high validity for both tests - a low correlation casts doubt on the validity of at least one of them. In a sense, one is carrying out a check on which Cronbach and Meehl define as content validity.

> *Content validity* is established by showing that the test items are a sample of a universe in which the investigator is interested. Content validity is ordinarily to be established deductively, by defining a universive items and sampling systematically within this universe to establish the test.
> (Cronbach and Meehl, 1955, p. 245)

The argument for split-halves reliability as a measure of validity is the same, except the sample A is now partitioned into two subsets A' and B', whose totals are correlated.

An index of the split halves variety, developed by Cronbach, is known as coefficient alpha or Cronbach's alpha. In his summary

Cronbach lists amongst its properties, the following:

> 2. α the general formula of which Kuder-Richardson formula 20 is a special case, is found to have the following important meanings:
>
> (a) α is the mean of all possible split-half coefficients.
> (b) α is the value expected when two *random* samples of items from a pool like those in the given test are correlated.
> (Cronbach, 1967, p.164).

(b) in particular, supports the concept of alpha as an index of validity, rather than reliability*.

From the traditional viewpoint, that of reliability, it could be argued that as tests A and B are not random samples, but carefully contrived equivalents, the thesis that the high correlation is unlikely unless they are valid, loses impact. In such a case, what does it mean? A low correlation could mean low validity or low reliability, or both. The confounding effect of reliability and validity renders the index virtually useless - except as an estimate of lower limits to validity - for this reason split-half correlation shall be dealt with in the section dealing with validity.
Cattell and Warburton also suggests caution in the use of this index as it relies on validity too much:

> As will be seen when we get to the more sophisticated matter of factor structure, however, an equivalent coefficient which is *too* high makes a test suspect. It may well mean that the two parts share not only the criterion factor which they are supposed to measure, but also the unwanted specifics or common factors.
> (Cattell and Warburton, 1967, p.42)

---

* These last two quotations from the same author taken together give considerable support to the notion that parallel forms or split-halves 'reliability' is a measure of validity.

The test-retest form of reliability estimate is not confounded by validity limitations, as the same test is used on both occasions. Test-retest reliability is often criticised because the same test must be administered twice. In order to reduce practice effects and other effects caused by this one should use a reasonably long test, one should make patterns of answering obscure, and one should have a reasonable time lapse between the first and the second administration. Care must be taken, however, that there is no factor variation between the two administrations, and therefor the time gap between the two administrations should be to an absolute minimum.

In this research, the test length was sufficient for the student to be unable to recall previous responses, the patterns of answering were definitely obscure, and the time between the first and retest administrations, one week, would be quite sufficient for specific recall of the questionnaire to lapse, with little, if any, change in the factors being measured.

Cattell and Warburton neatly summarise sources of variation that are likely to occur between two testings.

> (1) True function fluctuation, that is, oscillation or growth of the psychological entities themselves which the test sets out to measure.
>
> (2) Variation in the test score, *when the trait levels remain the same* is due to what *in toto* is called error of measurement resulting in from exmodulator influences. [This variation can be divided into a number of different classes, notably]

> (a) reversible or unordered error from differences in administrator, scorer, conditions of administration, and (b) irreversible, through the very fact of subjects having taken the test once, twice, and so on.
>
> (Cattell and Warburton, 1967, p.44).

Five different forms of reliability can be defined, and can be measured from test-retest experiments - dependability, administrative reliability, conspect reliability, pre-sophistication, and transferability.

5.3.2. Dependability

> *The coefficient of dependability, or 'circumstance reliability'*, which asks only how much the scores may alter on repeating the test when the same administrators, scorers, and controlable circumstances.
>
> (Cattell & Warburton, 1967, p.45).

This form of reliability was determined from the small sample of twelve randomly selected first year students (8 percent). In consideration of this small number, the resultant indices of dependability should be treated with some caution. Table 5.12 lists the obtained coefficients for each scale.

Table 5.12

Dependability

	Coefficient of Dependability	
Scale	Original Scales	Revised Scales
1	.71	.71
2	.79	.83
3	.79	.84
4	.78	.78
5	.69	.69
6	.93	.95
7	.85	.85
8	.45 (ns.)	.45 (ns)

It would be desirable for these indices to be higher, particularly for scale 8, and for scales 5 and 1. On the whole, however, the result seems to be satisfactory. The poor performance on scale 8 is in keeping with the nature of the scale, which was directed specifically at staff, and could not be answered by students (who of course made up this test-retest sample). In each case, the revised scales indices were as good or higher than the original scale indices.

5.3.3. Administrative Reliability

> *The coefficient of administrative reliability*, which evaluates how well a test is constructed in regard to the ability of the average administrator to maintain the given administrative instructions and conditions relative to another.
>
> (Cattell and Warburton, 1967, p.45).

The questionnaire was fully intended to be self-administered. It therefore would need to have a high administrative reliability (as well of course as a high situation transferability). The nearest measure of this is the values obtained from a systematic sample of 23 first-year students (16%) who completed the questionnaire first as members of a captive audience, and then again in their own time. These figures represent lower limits to administrative reliability, as they include situational variation. (In contrast, the figures in the previous table are upper limits to these figures.)

Analysis of these figures using Fisher's Z-transofrmations shows these not to be significantly different from the indices of dependability (both revised and original). This is an important finding, as it indicates that the questionnaire can indeed be self-administered with almost as great a reliability as under strict control. (If all results of the total test-retest group, (12 and 23 students) representing 24% of the group are combined for the calculation of dependability, some interesting changes to Table 5.12 occur. Scale 5 index drops to .47, and scale 8 rises to .52. The end result is that all indices are then statistically significant at $p<0.01$).

Table 5.13

Administrative Reliability

Scale	Administrative Reliability	
	Original	Revised
1	.69	.69
2	.76	.81
3	.76	.80
4	.67	.67
5	.33	.33
6	.78	.83
7	.70	.70
8	.58	.58

5.3.4. Conspect Reliability

> The coefficient of conspection, or 'conspect reliability coefficient', performs the vital function of indicating the degree to which two different psychologist scorers will obtain the same result for a given subject's set of responses.
>
> (Cattell and Warburton, 1967, p.46).

This is not an area for concern, as the questionnaires were of multiple choice form and were machine marked. The only source of potentential error is in the punching of ansers onto data cards, but as this was independently verified, the number of errors would be negligible or zero.

5.3.5. Pre-sophistication

> The coefficient of pre-sophistication or practice immunity .... has to do with the extent to which a test susceptible to practice effects from previous administration. All test parameter indexes are partly a function of the test characters themselves and partly of the population sample, but in the case of this coefficient it is obviously especially dependent on the experience of the group.
>
> (Cattell and Warburton, 1967, p.46).

The meaning of this index specifically precludes the recall of specifics, but refers to specific skills in answering this type of questionnaire. If the first administration was the subject's first experience of this type of questionnaire in the second attempt he will perform differently and the first measure would be inaccurate. The index is therefore sample-sensitive. However, it was known that at the test design stage that the sample had had experience with this type of test for a number of years, and thus this effect would be minimal.

5.3.6. Transferability

> Transferability ... is the tendency of a test to do the same thing, that is, to retain its particular validity, reliability, and homogenuity, despite changes in samples, populations, (subcultures, genetic groups) of people, or occasions.
>
> (Cattell and Warburton, 1967, p.49).

It can be seen from this quote, that Cattell and Warburton ascribe two clear meanings to transferability - the lower order meaning - that 'the test measures the same thing with changing populations' and occasions - and the higher order meaning - where one asks 'how constant are such first order parameter measures as validity (and reliability)... across different groups of people or samples of occasions .

Evidence for the former measure, that of transferability of test function across groups and occasions can be seen at least in part in Table 5.13 where test retest figures are given for administrative reliability. These figures are lower limits to transferability across occasions (lower limits as the figures compounded from different administrators and different occasions/situations). Further evidence can be seen in test-retest figures between the first and second administrations. Even though the second administration was conducted by mail, on the evidence of Table 5.14 one can assume administrative reliability and one can use the results of the sample of 82% who returned the mail questionnaire as a form of test-retest.

It can be seen from Table 5.14 that on the whole there is considerable stability. It should be kept in mind that this comparison incorporates factor variation as well as test variation The findings also indicate that as students progress they become less likely to change - and this suggests that the hypotheses are most likely to be supported by the third year student.

Table 5.14

Test-retest Figures
(revised scales)

		First - Second administration correlation		
Scale	Test-retest (First administration) First year only	First year N = 149	Second year N = 95	Third year N = 43
1	.69	.63	.63	.66
2	.76	.48**	.69	.83
3	.78	.71	.74	.68
4	.69	.62	.60	.78
5	.47	.38	.60	.62
6	.83	.55**	.70*	.81
7	.72	.56	.46*	.74
8	.52	.40	.57	.53
	(over all 35 students)			

Using test-retest (first administration) as a standard, significant differences are marked thus

** $\rho<0.001$
* $\rho<0.025$
all other figures $\rho>0.05$

There is no evidence regarding lower-order transferability across groups - indeed it would be impossible to determine in the conventional way, as it would be necessary for a set of subjects to change groups (sex or faculty, for example). The questionnaire was designed to be able to be administered to any group (in fact it was piloted with a sample of primary teachers - in-training). Nor is there any evidence of the higher order (parameter) transferability across groups, as the questionnaire has not been administered in its final form to any groups other than the Physics sample. There is some clue to its higher-order transferability across *occasions*, as the questionnaire was administered twice to the whole group. These shall be dealt with in Section 5, after validity has been discussed.

5.3.7. Reliability Summary

On all counts the questionnaire scales shared a considerable degree of reliability, once again poor results were obtained on the one scale that students could not answer.

Reliability, of course, is not the final arbiter of a good test. Cattell and Warburton (1967) warn:

> It may be that in two equally reliable tests one is more reliable than the other in that part which measures the wanted factor. (p.48).

Put another way, one does not know to what extent the reliability measured is that of the wanted factor or of some other extraneous factors. To some extent this is a hybrid question - relating to reliability and validity.

5.4. Validity

> Another unfortunate inheritance from the educational itemetric tradition .. is a viewpoint among teachers and educational psychologists which - *over values reliability and even homogeneity at the expense of validity.*
>
> (Cattell and Warburton, 1967, p.31).

Some inefficiency, unreliability, and reactivity may be acceptable in a machine or a process - as long as it does actually perform the function for which it was designed. This uncompromising requirement is fundamental to any activity - it must be effective. In psychological and educational testing, this is known as validity.

In short, a valid test is one that measures the functions it is designed to measure.

Validity is a most complex and elusive property of a measure and one must admit from the outset that concrete, irrefutable evidence of validity can only be obtained by weakening the definition of validity to allow subjectivity.

There are a considerable number of definitions of validity, but the three most accepted types are those of content validity, construct validity, and criterion validity. The last of these applies only when there exists a valid test of a criterion with which the measure can be consistently compared. In this area of research, there are no existing measures of the factors being measured by the student goal or staff role questionnaires, valid or invalid. For this reason, evidence of criterion validity will not be sought. The other forms of validity may apply, and will now be considered.

5.4.1. Content Validity

Content validity itself can be defined in three ways - by appearance, by assumption, or by definition. There is considerable debate surrounding the relative value of these definitions, but each has some merit.

By appearance: This form of content validity demands that a measure should appear valid to the layman and the experts. It is important that validity 'is seen to be done' and, indeed, it is sometimes important. As was mentioned in Section 1.1, to reduce reactivity, particularly from those who consider themselves experts, the appearance of validity is desirable, if it can be achieved without compromising real validity. There is very little value in it other than this.

> In the interest of the acceptability of the test to those most intimately concerned with its use, it is highly desirable that a test possess not only statistical validity, but also, as an added attribute, the appearance of practicality.
>
> (Mosier, 1967, p.218).

The low reactivity reported in Section 1 suggests that the questionnaires were valid by appearance as judged by the respondents relative to the explanation given on the frontispiece.

By assumption: Whilst a test may not appear valid to the layman, it may appear valid to experts. The experts could study the questionnaire and agree part-by-part on its validity. This form of validation is treated with great respect - far more than it deserves. The use of this kind of validation has been legitimised by quantification through a variety of voting techniques - without regard to the fact that the basis of the voting is very subjective. There is a role for this form of'validation', however, in that it often improves the chances of producing a test that is really valid - but that must be demonstrated another way - or, if the panel of experts do not really understand the function of the test, the result will be a jumbled measure. As it has often been said, 'a camel is a racehorse designed by a committee'.

Chapter 4 dealt with the development of the questionnaires. 'Experts' were consulted throughout that process, and where necessary improvements were made. No claim is made, however, that validity is assured in that manner.

By definition:

> The test sets such a task that the universe of possible tasks (of which the test is a representative sample) is the only practicable criterion, and the test is therefore a valid measure of the universe defined in terms of the sample. This implies merely that the test is a valid measure of whatever trait is measured reliable by the test.
>
> (Mosier, 1967 , p.218).

This form of validity closely resembles the definition of content validity of Cronbach and Meehl (1967) quoted earlier. It also bears close resemblance to split halves and parallel forms 'reliability' - which can be seen to provide a measure of the fidelity of the sample from the 'universe of possible tasks'. As measures of split-halves of validity (reliability) are available, a discussion of their nature and a report of the properties of these questionnaires in this regard will follow. 'Split-half' indices, as approximations of parallel form indices have two troubling weaknesses - they are determined from half the test, and they depend on the actual split used.

The latter problem requires more drastic action - utilisation of an altogether different index, Cronbach's described in part earlier, and in addition:

> (d) α estimates, and is a lower bound to, the proportion of test variance attributable to common factors among the items. That is, it is an index of common-factor concentration. This index serves purposes claimed for indices of homogeneity. α may be applied by a modified technique to determine the common-factor concentration a batter of sub-tests.
>
> (e) α an upper bound to the concentration in the test of the first factor among the items.
>
> For reasonably long tests not devisible into a few factorially-distinct sub tests. α is very little greater than the exact proportion of variance due to the first factor.
>
> (Cronbach, 1967, p.164).

Indicating that alpha casts some light on construct validity, to be discussed in Section 4.2.

Given that alpha is the mean of all possible split half coefficients, and that these reflect the *validity* of the scale, the information presented in Table 5.15 provide some measure of validity - at least a *lower* bound. (Correction for length of test, such as the Spearman-Brown formula, is not necessary for Cronbach's α).

Table 5.15

Coefficient for all scales, original and revised

Scale	Original Scale α Coefficient	Revised Scale α Coefficient
1	.446	.446
2	.632	.691
3	.608	.707
4	.432	.432
5	.403	.403
6	.622	.662
7	.609	.609
8	.163	.163

These figures differ from the reliability figures of Table 5.12 as expected (they tend to be lower as reliability figures represent upper-bounds to validity) but no direct comparisons can be made, because the two measures, (correlation and Cronbach's α) are quite different.

The most disturbing result, that of scale 8, is expected, as the figures were determined from student results, and students could not answer scale 8 validly. However, if the staff answers are considered alone, coefficient α is .793, a quite respectable result.

As in all other features - scale sensitivity, reliability, and now content validity, scale 5 performs badly - casting doubt on its value as a measure. Otherwise, the indication is that the measure is reasonably valid. (Very high figures are undesirable, as they would mean that each item was making very little unique contribution to the scale total - and this would imply inefficiency. See also Section 2.2 of this Chapter.)

The use of such indices implies that it is possible to define the variables in terms of universe of behaviours that would indicate their presence. This has not been done, and it is unavoidable that the items chosen reflect bias on the part of the test constructor. One does make a selection, however, on the basis of a nebulous construct or concept of the variable to be measured, and different validation techniques are required to investigate the result of measures.

5.4.2. Construct Validity

> Construct validation is involved whenever a test is to be interpreted as a measure of some attribute which is not 'operationally defined'. ... Construct validity is not to be defined solely by a particular investigative procedure but by the orientation of investigator ... construct validity must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured.
>
> (Cronbach and Meehl, 1967, p.245).

But what is a construct? It remains a loosely defined concept, as Cronbach and Meehl describe it:

> A construct is some postulated attribute of people, assumed to be reflected in test performance. In test validation the attribute about which we make statements in interpreting a test is a construct. (p.247).

And, in addition,

> (1) A construct is defined implicitly by network of associations or propositions in which it occurs. Constructs employed at different stages of research vary in definitiveness. (p.267).

And it is measured through equally indirect methods

> (2) Construct validation is possible only when some of the statements in the network lead to predicted relations among observables. While some observables may be regarded as 'criteria', the construct validity of the criteria themselves is regarded as under investigation.
>
> (3) The network defining the construct and derivation leading to the predicted observation, must be reasonably explicit so that validating evidence may be properly interpreted.
>
> (4) Many types of evidence are relevant to construct validity, including content validity, inter-item correlations, inter-test correlations, test 'criterion' correlations, studies of stability over time, and stability under experimental intervention. High correlation and high stability for the proposed interpretation, depending on the theories surrounding the construct. (p.267).

And finally

> (6) Construct validity can not generally be expressed in the form of the single simple coefficient. The data often permit one to establish upper and lower bounds for the proportion of test variance which can be attributed to the construct. The integration of diverse data into a proper interpretation cannot be an entirely quantitative process. (p. 267).

In this section, certain predicted effects will be stated and tested, dealing with a wide variety of perperties, to demonstrate the construct validity of these scales. The areas to be studied are group differences, interfactor correlations, and item - factor correlations.

Group Differences

There are four distinct groups in the sample - the first year, second year, third year students, and the staff. These groups will be expected to differ a number of the scales, or to lie in particular rank orders. We shall consider each scale in turn. The predicted rank orders were all derived before the data from the testing was available.

Amount of intellectual activity: (Scale 1). One would obviously predict that the order would be:

Staff > 3rd year > 2nd year > 1st year.

The means and standard deviations for this scale are given in the Table 5.16.

Table 5.16

Group differnces on Scale 1

Group	Mean	Standard deviation	Rank
1st year	28.0	2.8	4
2nd year	28.7	2.7	3
3rd year	29.3	2.5	2
Staff	30.9	2.8	1

Staff - 1st year difference significant at $\rho < 0.005$.

The figures in the table confirm the order predicted.

Diversity of intellectual activity (Scale 2): Increasing amount of intellectual activity will carry with it increasing diversity for the students. However, the staff, with their specialised areas of interest and research, should report low diversity. The expected order would thus be:

3rd year > 2nd year >1st year > staff.

The actual results are given in Table 5.17.

Table 5.17

Group differences on Scale 2 (revised)

Group	Mean	S.D.	Rank
1st year	20.4	3.1	3
2nd year	27.1	3.4	2
3rd year	27.3	3.4	1
Staff	26.1	3.5	4

3rd year-staff difference not significant.

Although the ranking in Table 5.17 reflects that predicted, this should be treated with caution because of the uncertainty in the prediction and the weak differences in the scores.

Acceptance of externally set goals or standards (Scale 3):
The staff are the most successful groups of a system where external standards are paramount. Not only that, they are now perpetrating the system by setting exams. One would expect them to be highest on the scale. Furthermore, as a student progresses, he is likely to accept these standards more and more (or else drop out), and so the order would be:
1st year < 2nd year < 3rd year < staff.

Table 5.18

Group differences on Scale 3 (revised)

Group	Mean	S.D.	Rank
1st year	21.3	3.8	4
2nd year	21.7	3.5	3
3rd year	22.3	3.0	2
Staff	24.1	4.2	1

1st year - staff difference significant at $p<0.01$

The information in Table 5.18 confirms the prediction.

Student flexibility (Scale 4): As one progresses through the system, one must adapt to changing environment - new lecturers, new ideas. If one is inflexible, one is likely to drop out. One could expect increasing group flexibility because of the attrition of this element, as the course progresses (staff, of course, are not involved).

Thus:

1st year < 2nd year < 3rd year.

Table 5.19

Group differences on Scale 4

Group	Mean	S.D.	Rank
1st year	12.0	2.3	2
2nd year	12.1	1.8	1½
3rd year	12.1	1.5	1½

1styear-2nd, 3rd year difference not significant.

Although not significant the figures confirm weakly the expected outcome.

Preoccupation with administration (Scale 5): One could expect some problems with this scale, as it performed very badly in the questionnaire in almost every feature. However, one could hypothesise that as staff are more closely associated with administration and are most fully aware of its usefulness, they would score highest. Suggesting a rank order for the students presents a dilemma - with increasing years they may become more aware of the need for administration, but grow more averse to its intrusion.

Based on what is little more than an intelligent guess, the order would be:

1st year< 2nd year< 3rd year <staff.

In actual fact, the order is different, at least as far as the third year students are concerned - they have the least preoccupation with administration.

Table 5.20

Group difference on Scale 5

Group	Mean	S.D.	Rank
1st year	24.5	2.5	3
2nd year	24.7	2.3	2
3rd year	24.3	2.8	4
Staff	25.0	3.3	1

3rd year-staff difference not significant.

Given the unreliability of this scale and the uncertainty of prediction, any resemblance between predicted rank order and actual rank order must be due to chance.

Preoccupation with Students (Scale 6): One should expect to find that the higher a student moves, the more desirous he becomes of involvement with staff, and hence the more he will report this as a desirable quality in a staff member. The staff members, on the other hand, will differ on this matter somewhat, and one would expect a greater spread and a moderate ranking - something like

3rd <2nd <staff <1st

or 3rd <staff <2nd <1st

The figures in Table 5.21 support the underlying rank order to the students, and the first of the two alternatives given above.

Table 5.21

Group differences on Scale 6 (revised)

Group	Mean	S.D.	Rank
1st year	26.1	2.8	4
2nd year	27.0	2.7	2
3rd year	27.1	2.7	1
Staff	26.5	3.6	3

3rd year - 1st year difference significant at $p<.025$

Preoccupation with Research (Scale 7): As the student becomes more steeped in physics, he shall become more attracted to research. The staff member shall naturally show the greatest identification with this activity, thus:

Staff > 3rd > 2nd > 1st

Table 5.22

Group differences on Scale 7

Group	Mean	S.D.	Rank
1st year	25.7	2.8	3
2nd year	25.5	2.4	4
3rd year	25.8	3.7	2
Staff	29.3	3.4	1

2nd year-staff difference significant at $p < 0.005$

The rank order has been reversed for the first and second year students, but consideration of the small differences between all the student groups, the actual rank order is inconsequential.

Staff Autonomy (Scale 8): The reliability of this scale for students was exceptionally low, differences are likely to occur by chance than by design. However, the expected rank order would be:

Staff < 1st year < 2nd year < 3rd year

where the staff rank reflects the recognition that in the items described staff have littly autonomy, and the remaining ranking the growing autonomy of the students themselves.

Table 5.23

Group differences on Scale 8

Group	Mean	S D.	Rank
1st year	12.7	1.7	3
2nd year	12.9	1.4	2
3rd year	13.1	1.6	1
Staff	12.1	1.6	4

3rd year-staff difference significant at $p<0.01$

Once again, the agreement in ranking is likely to be a chance event.

Of the eight rank orders predicted, three were matched precisely, three showed slight deviation, and two were some greater deviation. (Scales 4 and 5). It can be shown using Page's L test that the overall result is that the actual rankings match the predicted rankings very closely.

($L = 204$, $\rho<.001$)

Further support of the validity of the questionnaires can be found in an article by the writer (Docking 1973) reproduced in full in Appendix III, pages 44 - 46. Some predictions regarding the changes in student similarities to staff as they progress through their course based on a 'source of influence' questionnaire are tested independently by similarity figures calculated from the S.G.O. and S.R.O. scales. One is unequivocably reversed as the students become less like staff on S.R.O. scales. These results are discussed in full in the paper. Investigating the results of the data given in Table 9 of the paper a little further, one notes that there are five staff with whom students show less empathy on student roles, and four with whom they feel greater empathy on staff roles, the reverse of the trends for the remaining staff. Are these nine or so 'deviant' staff special in any way? The four from whom the students moved regarding the student roles had very similar staff role orientation structures. This is best illustrated by Table 5.24 along the similar data of the other group.

Table 5.24

'Deviant' Staff scores on all Scales (Revised)

	N		Scales						
			1	2	3	5	6	7	8
A. Staff from whom students moved on the student role scale (1,2,3)	5	MEAN	33.4	22.4	19.0	24.0	21.8	22.2	13.4
		S.D.	3.2	1.8	2.4	3.9	2.8	5.5	1.3
B. Staff towards whom students moved on the staff role scale (5,6,7)	4	MEAN	28.8	30.3	24.5	25.5	27.5	24.5	13.0
		S.D.	1.0	1.9	1.3	1.0	1.7	3.7	1.2
Total Staff Group:	30	MEAN	30.9	26.1	24.1	25.0	26.5	26.1	12.1
		S.D.	2.8	3.5	4.2	3.3	3.6	3.6	1.6

Comparing groups A and B one finds the following:

(a) Group A is quite heterogeneous: Group B quite homogeneous.

(b) Group A scores very high on: Amount of intellectual activity and Low on: Student diversity of intellectual thought, acceptance of external standards, preoccupation with administrations, preoccupation with students, and preoccupation with research. They are, in fact, very much 'misfits' in the university.

(c) Group B, on the other hand, score high on: Diversity in intellectual activity, preoccupation with students, and low on: Amount of intellectual activity, preoccupation with research and average on the remainder.

The students, it seems, are moving away from the 'misfit' staff on the scales measuring student goal orientation, and towards a student centred staff group on the scales measuring staff role orientation. These findings are conceptually congruent with the scales and their definitions. There is more valuable evidence that could be presented at this point regarding the staff members 'identified' by the students changes. However, this cannot be included here as it would enable them to be identified, contrary to the undertaking to preserve anonymity given with the questionnaires.

Other group differences reported earlier that could be mentioned here can be found from the performance of Scale 4 when staff answered, and Scale 8 when students answered. Scale 4 was designed specifically for student response, and Scale 8 for staff response.

Table 5.25

Group differences on Scales 4 and 8

Scale 4		Scale 8	
Students	Staff	Students	Staff
Low-non response	High non-response	Poor item balance	Balance satisfactory
		Low dependability	(Not tested)
High α (.432)	Low α (.053)	Low α (.163)	High α (.793)

Table 5.23 shows the evidence available. The staff-student differences reflect the groups for which the scales were supposed to be valid.

From the point of view of group differences, validity appeared to be supported for all scales. The slightly 'shady' areas are not too disquieting , for as Cronbach and Meehl comment:

> Only coarse correspondence between test and group designation is expected. Too great a correspondence between the two would indicate that the test is to some degree invalid, because members of the group are expected to overlap on the test.
>
> (Cronbach and Meehl, 1967, p.251).

Scale Correlations

Various hypotheses can be formulated about inter-scale correlation and correlations between scales and items and scales and other variables. Consider first the inter-scale correlations.

Volume of Intellectual Activity (Scale 1)

This variable would be expected to have the following characteristics with the other scales:

Scale 2.	Diversity	Positive correlation preferably almost zero (a 'pure' scale), positive because 'breath' is an almost unavoidable component of 'volume'.
Scale 3.	External motivation	Zero correlation - no intended relationship.
Scale 4.	Student feasibility	Positive correlation as greater 'volume' offers greater freedom. Small value desired.
Scale 5.	Administration	Zero correlation - no intended relationship.
Scale 6.	Students	Zero correlation - no intended relationship.
Scale 7.	Research	Positive correlation - the activity of research is one of much intellectual activity.
Scale 8.	Staff autonomy	Zero correlation - no intended relationship.

Diversity of Intellectual Activity (Scale 2)

This variable could be expected to have the following characteristics with the other scales.

Scale 3.	External motiviation	Negative as increasing diversity and freedom are contrary to external demands.
Scale 4.	Student flexibility	Small, positive correlation - diversity and flexibility could occur together.
Scale 5.	Administration	Small, negative correlation - administration does not engender diversity.
Scale 6.	Students	Positive correlation - the acceptance that students are intellectually diverse.
Scale 7.	Research	Positive correlation, small, as research entails specialisation but respects diversity.
Scale 8.	Autonomy	Zero correlation - no expected relationship.

Willingness to Accept Externally Set Goals and Standards (Scale 3)

This variable could be expected to have the following characteristics with the other variables.

Scale 4.	Student flexibility	Negative. Acceptance of the uniform, external set of standards denies the students flexibility.
Scale 5.	Administration	Positive, administration in students external standards.
Scale 6.	Students	Zero correlation - no expected relationship.
Scale 7.	Research	Zero correlation - no expected relationship.
Scale 8.	Staff autonomy	Negative, as external standards are contrary to staff autonomy.

Student Flexibility (Scale 4)

This variable could be expected to have the following characteristics with the other variables.

Scale 5.	Administration	Zero - no expected relationship.
Scale 6.	Students	Zero - no expected relationship.
Scale 7.	Research	Positive, flexibility is an attribute of a good researcher.
Scale 8.	Staff autonomy	Positive, student flexibility should be an empathy with staff autonomy.

Preoccupation with Administration (Scale 5)

This variable could be expected to have the following characteristics with the other variables.

Scale 6.	Students	Zero - no intended relationship.
Scale 7.	Research	Zero - no expected relationship.
Scale 8.	Staff autonomy	Negative - autonomy and administration are antithetical.

Preoccupation with Students (Scale 6)

This scale could be expected to have the following characteristics with the other variables.

Scale 7.	Research	Zero - no expected relationship.
Scale 8.	Staff autonomy	Zero - no expected relationship.

Preoccupation with Research (Scale 7)

This scale could be expected to have the following relationship with the remaining variable.

Scale 8. Staff autonomy	Positive, freedom is conducive to research.

A summary of these predicitions and the actual results obtained is given in Table 5.26.

Table 5.26

Predicted and Actual Scale - Scale Correlations

	2	3	4	5	6	7	8
1. Amount of intellectual activity	0+ .075 .100	0 .059 .076	+ .269 .269	0 .043 .043	0 .081 .045	+ .309 .309	0 -.006 -.006
2. Diversity of intellectual activity		- -.208 -.255	0+ -.006 -.020	0- -.059 -0.070	+ .428 .470	0+ .058 .079	0 .125 .142
3. Acceptance of externally set goals and standards			- .263 .293	+ .333 .319	0 -.222 -.298	0 .011 .037	- -.327 -.354
4. Student flexibility				0 .029 .029	0 -.105 -.137	+ .168 .168	+ -0.109 -.109
5. Preoccupation with administration					0 .004 -.046	0 .036 .036	- -0.163 -.163
6. Preoccupation with students						0 .190 .146	0 .201 .218
7. Preoccupation with research							+ -0.019 -0.019
8. Staff autonomy							

(Predicted results upper, actual results from original scales middle, results from adjusted scales lower).

Table 5.27

Agreement between Predicted and Actual Correlation

	-	0^-	0	0^+	+	Total
Predicted	4	1	13	3	7	28
Agreement	3	1	9	2	5	20

Eight of the twenty eight correlations were different in nature to the predictions. Of these only one represented a significant polarity change (Scale 3 with Scale 4) - the others represented minor changes around zero, or in emphasis.

These results add further support to the claim of validity for each scale.

Item - Scale Correlations

Correlations between items and their own scales have already been discussed under reliability (Section 3). The correlation of items with other scales yields some insight into the validity of the scales. At normal levels of significance (0.05) one can expect 28 correlations of the 560 correlations to be significant by chance. For the purpose of this validation, correlation tables were searched for each scale for two items from each of the SGO and SRO questionnaires with the highest item - scale correlation (not including items from the scale itself). In a sense, this is a *post hoc* analysis, as hypotheses have not been proposed in advance. None-the-less, if the items support the general definition of the scales, or bear a logical relationship, they could be said to support validity. The results of this search are presented in Table 5.28.

Table 5.28

Items with Greatest Relationship to Scales

Scale	Sect	No.	Item	Item Scale Correlation
Volume of intellectual activity (Scale 1	SGO	27	When lecturers have different view of a university education students become confused about what to learn.	-.294
	SGO	29.	Tertiary education should emphasise a deep involvement with ideas, whether scientific or humanistic.	.241
	SRO	6.	Not encourage students to participate in research project.	-.305
	SRO	34.	Confine his lectures to the text, avoiding references to recent research findings in the area.	-.343
Diversity of intellectual activity (Scale 2)	SGO	10.	Tertiary education should encourage students to think in depth.	.319
	SGO	32.	A university education should serve to develop the intellect.	.236
	SRO	17.	Avoid discussion of political and social issues with students.	-.356
	SRO	29.	Be patient with students who stress their own individuality.	.312
Motivation to meet externally set goals & standards (Scale 3)	SGO	5.	Tertiary education should provide a specialised understanding of one field of knowledge.	.276
	SGO	27.	When lecturers have different view of a university education students become confused about what to learn.	-.233

Table 5.28 (Cont'd.)

Scale	Sect	No.	Item	Item Scale Correlation
	SRO	23.	Be able to select the content matter of courses, free from direction by others in the faculty or university	-.381
	SRO	31.	Strive to maintain a good public image of the university	.397
Student flexibility (Scale 4)	SGO	6.	Assessment is contrary to the ideals of a university.	-.285
	SGO	34.	Examinations distort the true purpose of tertiary education - learning for it's own sake.	-.314
	SRO	9.	Be encouraged to keep up with latest developments in his field by practical means such as study leave.	.218
	SRO	23.	Be able to select the content matter of courses, free from direction by others in the faculty or university.	-.216
Preoccupation with administration (Scale 5)	SGO	2.	A university education should develop a lively intellectual interest in a wide range of topics.	.276
	SGO	22.	Assessment is necessary if standards are to be maintained.	.244
	SRO	31	Strive to maintain a good public image of the university.	.340
	SRO	33.	Treat students as subordinates rather than as equals.	.245
Preoccupation with students (Scale 6)	SGO	29.	Tertiary education should emphasise a deep involvement with ideas, whether scientific or humanistic.	.348
	SGO	34.	Examinations distort the true purpose of tertiary education - learning for it's own sake.	.372
	SRO	13.	Insist that this status as a staff member be recognised.	-.335
	SRO	27.	Act on the comments of students about courses.	.460

Table 5.28 (Cont'd.)

Scale	Sect	No.	Item	Item Scale Correlation
Preoccupation with research (Scale 7)	SGO	24.	Universities should provide facilities for students to engage in extensive study.	.213
	SGO	28.	These are the best years of your life and should not be wasted on study.	-.254
	SRO	5.	Not encourage students to join professional associations.	-.211
	SRO	6.	Not encourage students to participate in research projects.	-.349
Staff autonomy (Scale 8)	SGO	6.	Assessment is contrary to the ideals of a university.	.277
	SGO	34.	Examinations distort the true purpose of tertiary education - learning for it's own sake.	.248
	SRO	13.	Insist that his status as a staff member be recognised.	-.181
	SRO	[illegible]	Treat students as subordinates rather than as equals.	-.222

A review of the information confirms the impression that each scale is valid. In most cases, a direct link can be seen, in some, the relationship is less obvious, such as for Scale 3 item 5. (it would be easier to identify the external goals if the Institute concentrated on narrower fields of study), and others show inexplicable relationships (Scale 4, item 6 and 23; Scale 5, item 2).

Scale - Background Correlations

A comprehensive set of background information was obtained in Part A of the questionnaires. Information about age, sex, scholarship, S.E.S., ambitions, residence were obtained from the students, and H.S.C. physics marks from records. Of these, scholarship and ambition do not represent real scales - residence was a notional scale of individual freedom. No significant correlations were hypothesised between scales and background data, and in fact, few were found. H.S.C. aggregate score was significantly correlated with volume, flexibility, and research, (Scales 1, 4 and 7) and H.S.C. physics score with volume and flexibility (Scales 1 and 4) only. No other educationally significant correlations were found.

These results support the transferability requirement of a good measure. They are not sensitive to the background variables in a systematic way.

5.4.3. Validity Summary

Throughout this section evidence has been accumulated to test validity of the scales. On each aspect of validity and with each scale, the evidence lends support to the claim that the scales are valid. One is still unable to say with certainty that they are, but, all the evidence available suggests they are, that must be the final conclusion.

5.5. Further Properties

Cattell and Warburton bring to our attention a number of other characteristics, viz. scaling and transferability (higher order).

5.5.1. Transferability

The definition given in Section 3.6 included the consistency of the test parameters themselves (reactivity, efficiency, reliability and validity) across groups and occasions. This property can be studied to limited extent across different physics groups and across different occasions (first and second administration).

Across Groups: Table 5.29 offers information in this regard.

Table 5.29

Variation of Cronbach's α Across Groups

	Physics Group				
Scale	First Year	Second Year	Third Year	Students	Staff
1	.41	.40	.33	.41	.54
2	.65	.74	.70	.69	.75
3	.70	.68	.58	.68	.85
4	.52	.31	.13	.42	.58
5	.32	.35	.57	.37	.61
6	.63	.66	.62	.64	.83
7	.44	.44	.76	.52	.76
8	.22	.01	.28	.15	.79

No estimates of what constitutes significant differences for these indices are available. The most marked variations are to be found in the staff, and third year groups, as could be expected because of these small sizes, and in Scale 8, because of its particular relevance to staff. The results for the three largest groups, the first and second year and all students, are quite similar.

Across occasions: Table 5.30 shows the variation in properties across occasions.

Table 5.30

Variation in Cronbach's α Across Occasions

Scale	First Administration	Second Administration
1	.45	.34
2	.69	.71
3	.71	.71
4	.43	.46
5	.40	.32
6	.66	.69
7	.61	.65
8	.16	.18

There is a high degree of similarity between these figures indicating good transferability across occasions.

Other evidence of stability is given below:

Variance on each scale: no significant changes ($\rho \leq .05$) by year or for whole group.

Means on each scale: no significant changes ($\rho \leq .05$ by year or for whole group.

Scale - scale correlations: no significant changes ($\rho < .05$)

It can be concluded, that the properties of these scales are transferable over groups and occasions.

5.5.2. Utility

How useful could these scales be in other fields of research? This largely philosophical question is important if the development of these questionnaires is to have any significance beyond this research, and is required to justify the investment of effort made in them. The topic will be discussed at greater length in the final chapter, but a number of applications are readily apparent.

Student-Institution/course compatability: To enable the student to select the most suitable institution and course for further studies.

Lecturer/Institution compatability: To encourage homogeneity or diversity in staffing.

Staff/student familiarity: To assist these groups to understand each others academic goals and standards.

Research into staff/student interaction in other fields and in other tertiary institutions.

5.5.3. Scaling

The scaling technique used in this study is intended to achieve normally distributed scales by the assumption that the equally weighted items provide equal intervals. The achievement of normality can be checked by the comparison of the actual distribution and the normal distribution, using the Kolmogorov-Smirnov test. This was conducted on all scales, and none deviated significantly ($\rho<.05$) from normal, or on any other measure of spread, or skewness. The achievement of this fidelity suggests not only that the scaling assumptions are satisfied, but also that parametric techniques can be used with confidence on the scale data. (As indeed they already have been).

5.6. Conclusions

It must bring some relief to the reader to reach this point in this lengthy and rather tedious chapter. It brings no less relief to the researcher to know that the instruments derived from theory and applied to an experiment measure up well against a searching interrogation. The quality of these questionnaires has been demonstrated through every conceivable enquiry.

CHAPTER 6

ANALYSIS AND FINDINGS

Now that instruments have been developed (Chapter 4) and validated (Chapter 5) all that remains is to test the hypotheses developed in Chapter 3.

The population selected to be used in the 'experiment' is described briefly in Chapter 3, more detail will follow in the first section of this chapter. It should be stressed that the data used in the experiment was the same as used to validate the instruments. This is a practice usually frowned upon, but only when the validation is conducted with criteria related to the hypothesis to be tested. This is not the case in this study - the criteria used to validate the instruments are distinct from the experimental criterion-academic achievement - and the hypothesis. Differences in achievement were not used to validate item responses, or the VOL scale, for example, as might have been, and patterns of staff-student similarity were not sought.

Differences between year groups were used, and this is as close to violating the convention as the validation gets. Comparisons between years, however, are distinct from comparisons within years, and simply tempt one to press further on in the testing of the hypothesis without invalidating that research.

The largest single group of students used in this study were included for validation and test-retest studies only and not used in the tests of the hypotheses. (Physics 101 students).

6.1. Sample Characteristics

6.1.1. Population Characteristics

A physics department at a University was chosen to be the group with which the study would be conducted. The reasons for this choice are given in Chapter 3, but briefly they are:

1) Relatively reliable examinations
2) Limited feedback in and after lectures
3) One lecturer for each examinable part of each course
4) Relatively homogeneous lecture presentation and assessment techniques
5) Background of researcher. (Useful in observation of lectures and analysis of examinations).

In addition, there is the advantage of a relatively objective discipline. The likelihood of detecting the type of interaction is minimised by the selection of an area of high objectivity - hence the generalizability of any interaction effects that may be substantiated would be greater.

The Physics course was taught at all levels in the traditional lecture/demonstration - laboratory type way. Each section of each course was assessed once only, at the end of the semester.

Students taking Physics as a major study only were the target group, although first year Physics group, the largest group (N= 153) were used for validation and test-retest exercises, even though not all would eventually major in Physics.

The year groups are set out in Table 6.1.

Table 6.1.

Population sub-groups

Year Group	Description	Number (population)
Physics 101	General first year course.	153
Physics 201	Second year major course, studied with another minor unit.	40
Physics 203	Second year major course, studied with two minor units.	57
Physics 301	Third year major course, no other studies.	21
Physics 303	Third year major course, studied with a minor unit.	23

Physics 101 does not meet the requirements of the study, mainly because team teaching and examining processes were used, and hence the group could not be used in testing the hypotheses.

Physics 303 failed to meet the statistical requirement that all students experience the same treatments. These students were able to choose four physics units from ten optional ones, in addition to three compulsory units. The analysis was therefore not conducted with this group.

The remaining three groups (Physics 201, 203 and 301) met all environmental and statistical requirements discussed in Chapter 3.

The Physics Department had 31 staff who taught in various years, shown in Table 6.2. (The code numbers are fictitious).

Table 6.2

Staff Teaching Distribution

Year Group	Staff	
Physics 201	4, 5, 8, 9, 11, 12, 13.	7 different lecturers
Physics 203	5, 8, 9, 11, 12.	5 different lecturers
Physics 301	1, 2, 3, 4, 5, 6, 7, 8, 9, 10.	10 different lecturers
Physics 303	1, 2, 3, 4, 5, 6, 7, 8, 9, 10.	10 different lecturers.

Of the 31 staff, only 13 taught in these courses - others taught in service courses, Physics 101 only, or were not engaged in teaching at all.

6.1.2. Sample Characteristics

As the experiment was a natural one, the sample is defined in terms of students who answered the questionnaires. The initial part of this section will describe how this was done.

Shortly before the end of the first semester, access was obtained with the assistance of the Department to time in the normal lecture sessions of each Physics group. The administration of the questionnaires, which was not speeded, took about twenty minutes for the slowest student.

Three administrations only were required, within one week. The 301 and 303 groups were tested first, followed by the 101 group, and then by the 201 and 203 groups. All were administered in lecture threatres, in the morning, by the researcher and assistants.

Students not present at these sessions were asked for by name at three later sessions in each group, and requested to complete a questionnaire.

Those who failed to reply were gently reminded by mail some short time later. (See Appendix I).

One week after the administration, a systematic sample of 50 Physics 101 respondents was selected for test-retest trials. These were sent a second copy of the questionnaire and an explanatory letter. (See Appendix I).

The results of these administrations are summarised in Table 6.3.

In table 6.3. the test-retest group is split into two. Group one were administered the test in the follow-up sessions, and the re-test by mail, and hence completed both questionnaires in an uncontrolled environment. Group two completed the test in the theatre, and the retest by mail, and hence provided a measure of situational dependence.

Table 6.3

First Administration Numbers

	Population	Sample	Percentage of population
Physics 101	153		97
Physics 201	40	39	98
Physics 203	57	56	95
Physics 301	21	21	100
Physics 303	23	22	96
Physics 201, 202 301 and 303	141	138	98
All students	294	287	98
Test-retest group one	20	12	60
Test-retest group two	30	23	77
All test-retest	50	35	70
Staff	31	30	97

Staff members were approached individually, or by internal mail if unavailable. (See Appendix I). The questionnaires were not always well received, but all but one staff member eventually responded. (See Chapter 5, Reactivity for further comments).

The high sample percentages reflects the co-operative mood of the staff and students, and the effectiveness of the explanation accompanying each questionnaire as an introduction.

The second administration, which took place in the last week of the second semester, was chiefly designed to test for stability of orientation. As test-retest results from the first administration showed that the administrative environment did not seriously affect the results (see Chapter 5, Reliability), the second administration was conducted by mail. Follow-up letters were sent some time later to non-respondents, eventually boosting the response rate to 82% (See Table 6.4). This rate is quite remarkable, considering it was obtained by mail, in the week of the students' final examinations!

Astin (1970b, p. 445) is strongly supportive of the use of mail administration:

> The most serious problem with group follow-up testing at the institution is that it excludes dropouts and early graduates. As a consequence, generalizations concerning environmental influences are limited to what may be the least affected group of students. A more subtle problem is the effects of college on the student's tendency to drop out may be confounded with college 'effects' on other outcomes. If dropout-proneness is correlated with changes in other student outcomes, then those institutions that encourage potential dropouts to stay in college also will appear to 'affect' these other outcomes. One protection for the researcher here would be to see if these other'effects' hold up once he has controlled for the institution's dropout rate. In other words, he might use the institution's dropout rate as a kind of input or control variable.
>
> Perhaps the most realistic alternative to group follow-up testing at the institution is the mailed questionnaire sent to the student's home. This technique permits the investigator to follow-up all or a random sample of all entering students, including those who have dropped out or transferred. In one sense, the self-administered questionnaire represents the most unstandardized of all data collection techniques. The real methodological advantage here, of course, is that these extreme variations in the conditions of administration are confounded in the interinstitutional comparisons. The reduction in precision that results from this confounding is a small price to pay in order to eliminate the systematic biases that almost inevitably result from follow-ups carried out at the institution.
>
> The principal methodological limitation of the mailed questionnaire is that not all students will cooperate, and that those who do complete and return the questionnaire are likely to be a biased subsample of the total group to whom questionnaires are sent.

Astin then continues to suggest techniques of compensating for such a bias. In this study, the problem of bias is not likely to be major, as there was a high response rate. Nonetheless, some investigation comparing first administration and second administration samples is undertaken.

Table 6.4

Second Administration Numbers

	Number	Percentage of population	Percentage of first administration
Physics 101	113	74	70
Physics 201	32	80	91
Physics 203	52	91	93
Physics 301	19	91	95
Physics 303	19	83	95
Physics 201, 203 301 and 303	122	87	88
All students	235	80	82

In the first administration only one student refused to complete the questionnaire. All other non-respondents were unobtainable. In the second administration a total of 17 questionnaires were returned unopened marked 'Not Known', and the remaining 42 appeared to be direct refusals, or students who withdrew from the course.

The characteristics of the two administration samples, by the criteria requested in Section A, can be seen in Table 6.5. The second administration figures were obtained by considering the second administration sub-sample of the first administration, on data obtained in the first administration. (Part A was not in both questionnaires).

Table 6.5

Sample Characteristics

Group	Physics 101	Physics 201	Physics 203	Physics 301	Physics 303
Age	18.6	19.6	19.9	21.3	21.7
	18.4	19.5	19.9	21.2	23.0
Approximate sex ratio Male : Female	3.5 : 1	4.5 : 1	11.5 : 1	20 : 1	10 : 1
	4 : 1	4.5 : 1	12 : 1	18 : 1	9 : 1
S.E.S. 7 pt (Congalton)	4.2	4.5	4.2	4.4	5.1
	4.4	4.6	4.1	4.4	5.0
Residence	1.7	1.8	1.9	2.2	1.9
	1.8	1.8	1.9	2.3	2.0
H.S.C. aggregate	216.7	220.8	221.8	232.7	207.5
	218.4	219.9	221.4	232.3	209.2
H.S.C. Physics	71.4	75.6	75.1	81.8	70.3
	71.7	75.8	74.8	81.3	70.7

First Administration sample figures upper; second administration sample figures lower.

Socio-economic Status (SES) was measured using Congaltons (1969) 7 - point scale, based on a description of the occupation of the head of the family.

Residence is a notional measure of independence in lodgings, on the scale: Home with parents (1), Affiliation hall of residence (2), University Hall of Residence (3), Boarding with friends or relatives(4)

Shared flat or house (5) and Own flat or house (6). Differences between first and second administration will not only reflect mortality, but also change in residence.

The first and second administration figures suggest that the second administration is equivalent to the first administration in all measured respects. (No significant differences).

If one compares the second administration subsample with the first administration sample on the SGO and SRO scales as measured in the first administration, one again finds no significant differences. (See Table 6.6).

Table 6.6

First and Second Administration Samples
SGO and SRO First Administration

	VOL	BRE	MOT	INST	STD	RES
N = 287	28.42	26.77	21.58	24.54	26.55	25.62
N = 235	28.42	26.84	22.33	24.41	26.19	25.38

All the evidence available suggests that the subsample obtained in the second administration is equivalent to the first administration total sample, at least on group criteria. It is more important to study individual changes, however, and this is done in the next section.

6.2. Test of Assumptions

Three main assumptions arising from Chapter 3 required some form of testing. The assumption of limited feedback in lectures was tested by the unstructured observation of a series of three lectures given by each of the thirteen lecturers involved with the students. Whilst occasional dialogue did occur between student and teacher, this was a very rare occurrence with all lecturers. These observations were made in the very early part of the study, at which time various alternative populations were being considered.

The requirement that there be significant overlap between staff and students on their scale scores is important to maximise the variation in similarity measures. The scales met this requirement, as demonstrated in Table 6.7.

Table 6.7

Staff-student Overlap

Scale		Staff (N = 30) Mean	Range	Students (N = 287) Mean	Range
Volume	VOL	30.91	27 - 36	28.4	20 - 36
Diversity	BRE	28.0	20 - 33	28.6	16 - 35
Motivation	MOT	26.21	11 - 32	24.5	10 - 34
Administration	INST	25.0	15 - 30	24.6	15 - 30
Student	STD	29.3	19 - 35	29.2	18 - 35
Research	RES	25.91	18 - 33	25.6	17 - 37

The significance of differences are discussed in Chapter 4. It is sufficient to note that the lecturers' scores in every case are a subset of the student scores, not a mutually exclusive set as is often the case.

The last requirement to be satisfied is the most difficult to substantiate. The stability of SGO and SRO scores is important for two reasons, namely that the effect of the incongruity between student and staff member could be greater if the incongruity was persistent, and secondly that stability would enable the results of both semester examinations to be used in the analysis. In terms of Page's L test, this would increase the value of n (treatments) by a factor of two, increasing the sensitivity of the test.

A bulk measure of stability can be found by comparing group means on bulk scale in the first and second testing. These are shown in Table 6.8. (The first administration figures are for the second administration sub-set).

Table 6.8

Group means, First and Second Administration

S G O			S R O		
VOL	BRE	MOT	INST	STD	RES
28.13	26.73	21.94	24.59	26.41	25.44
28.42	26.84	22.33	24.41	26.19	25.38

None of the differences in Table 6.8 are significant at $p<.05$ suggesting overall stability. But what about stability at an individual level?

A simple 'test'retest' correlation could be determined from the two administrations for each scale. These have been calculated and are described in Table 6.9.

Table 6.9

Scale Test-Retest Correlations
First and Second Administrations

	First Year	Second Year	Third Year
VOL	.63	.63	.66
BRE	.48	.69	.83
MOT	.71	.74	.68
INST	.38	.60	.62
STD	.55	.70	.81
RES	.56	.46	.74

The real concern is whether or not a student has changed his orientation as a whole. The most logical way to measure this is to determine his similarity with himself in the two administrations, by use of the indice r_p (Cattell, 1949).

Tables to determine the significance levels of r_p have been developed (Horn, 1961), but if one is interested in stability overall, cumulative frequency distributions of r_p must be considered. If these can be prepared for the observed r_p and for the ideal cases of $r_p = 0$ and $r_p = 0.9$ and $r_p = 1.0$, comparisons can be made by a test of distribution similarity. (Kolmagarov-Smirnov).

The hypothetical distribution for $r_p = 1$ can be generated by the following argument:

$$r_p = \frac{E_k - \Sigma d^2}{E_k + \Sigma d^2}$$

where E_k is twice the sum of the squared latent roots of the correlation matrix of factors.

Now, as scores as standardized, $\alpha = 1$, hence the value of d^2 at n standard errors of measurement is given by

$$\underset{n\ SEM}{\Sigma d^2} = n^{\frac{1}{2}}[3 - (r_{11} + r_{22} + r_{33})]$$

Given n, r_{11}, r_{22} and 5_{33} (from Chapter 3) one can determine Σd^2.

E_k is a function of R which can easily be calculated, and hence ${}^{r}_{n}P_{SEM}$ can be determined.

The relevant figures are given in Table 6.10.

Table 6.10

Data for Hypothetical $r_p = 1$.

	SGO	SRO	Cumulative frequency
E_k	3.268	3.032	-
$\underset{1\ SEM}{d^2}$	.93	1.25	-
$\underset{1\ SEM}{r_p}$	.56	.42	32%
$\underset{\frac{1}{2}\ SEM}{r_p}$	.87	.81	62%
$\underset{2\ SEM}{r_p}$	-.06	-.25	5%

These distributions are plotted as the lower curve in Figure 6.1. (SGO) and Figure 6.2. (SRO).

The distribution for $r_p = 0$ can be determined from the tables of Horn (1961). This is also plotted on Figures 6.1 and 6.2

The distribution for $r_p = .9$ was determined by linear interpolation between $r_p = 1$ and $r_p = 0$, assuming the distribution to be approximately rectangular in that region. The .9 level of r_p was selected as this has a significance value of $\rho<.0.01$ (Horn, 1961, adjusting for difference in X^2).

The distributions actually obtained are drawn on the appropriate figure (SGO Figure 6.1., SRO Figure 6.2), as shown below:

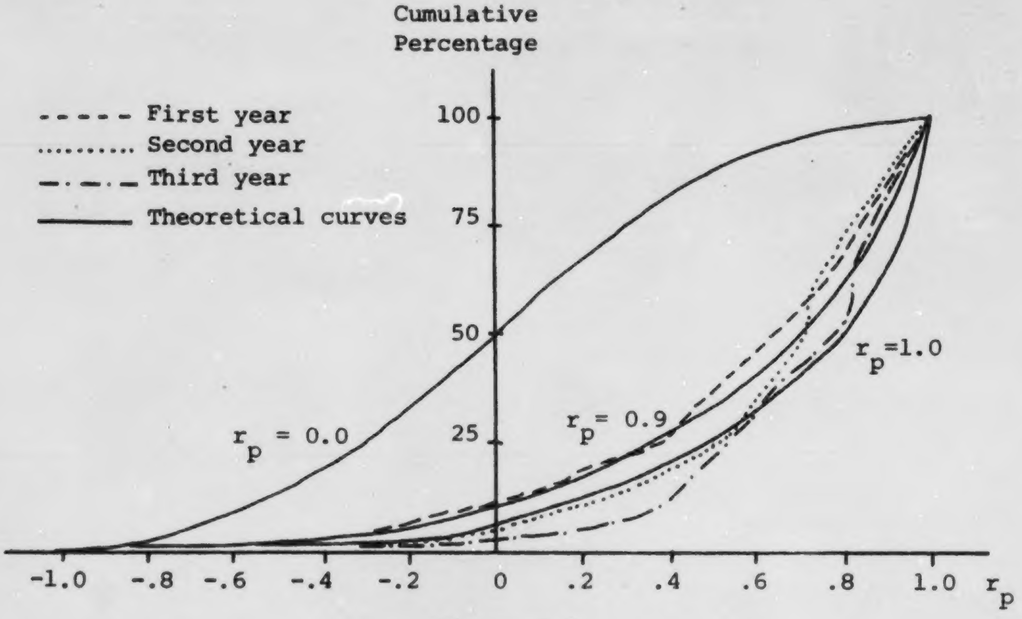

Figure 6.1.

Distribution of SGO r_p Value

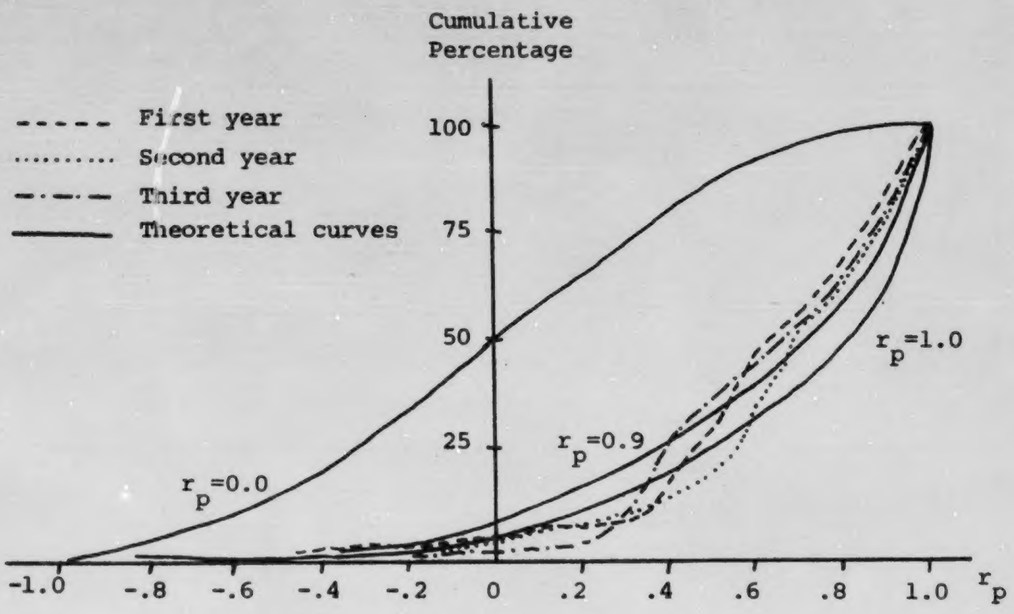

Figure 6.2.

Distribution of SRO r_p Values

As can be seen from these figures, the curves for each group tend to lie within the envelope of $r_p = .9$ and $r_p = 1.0$, except for high values of r_p ($r_p < .6$).

Kolmogonov-Smirnov tests were conducted with each curve, and the results reported in Table 6.11. The Table shows the distribution

Table 6.11

Significance Tests of r_p

Year group	SGO	SRO
Physics 101	.9	.0
Physics 201/203	.9	.9
Physics 301/303	1.0	1.0
Physics 201, 203, 301 and 303	.9	.9

curve (r_p = 0.0, 0.9 or 1.0) from which the observed curve did not differ significantly, at $\rho < .05$.

The figures indicate that the students in the experiment (second and third years) did not change significantly over one semester.

Their curves did not differ from that expected if no change (r_p = 1.0) or little change (r_p = .9) had occurred, given the errors of measurement of the tests. The greater change in Physics 101 could be ascribed to real change, or to high mortality between first and second testing (23%).

One can only conclude from this evidence that the student goal orientation and the staff role orientation is in fact stable over a long period of time, and that its effect, if any, will be continuous and potentially cumulative, and that data obtained from the first half to the year may be included with that obtained in the last half.

6.3. Tests of Hypotheses

In general terms, the hypothesis states:

H2 - Holding other variables constant, the greater the degree of similarity in style of intellectual functioning between student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

In statistical terms, this is stated as:

HS2 - Given student achievement rankings Xij for student i with lecturer j, and lecturer/student similarity rankings Yij, in any group where all m students have a common set of n courses, then the statistics $L = \sum^{m} (\sum^{n} Xij\ Yij)$ will be significant at least at the 0.05 level.

The term staff-student similarity in each of these refers to similarity measured on two (demonstrably) independent criteria: the SGO and the SRO scales. These will now be discussed separately.

6.3.1. The SGO Scales

H2 can now be restated as:

H2 - Holding other variables constant, the greater the degree of similarity in Student Goal Orientation between student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

and HS as:

HS2 - Given student achievement rankings Xij for student i with lecturer j, and lecturer/student SGO similarity rankings Yij, i- any group where all m students have a common set of n courses, then the statistic $L = \sum^{m} (\sum^{n} Xij\ Yij)$ will be significant at least at the 0.05 level.

To test this hypothesis, the following procedure was followed:

1. Standardized scores of each student were obtained from each part of the course. (7 in Physics 201, 5 in Physics 203, 13 in Physics 301, and 7 in Physics 303). These were compiled onto a single form.

2. Similarity indices on the SGO scales were calculated for each student with each of the thirty lecturers. The indices for the appropriate lecturers were identified for each student and recorded on the same sheet as in 1.

The Table so produced looked like Table 6.12, which is in fact part of an actual Table. Standard scores are shown upper left, and the SGO similarity indices lower right.

Table 6.12

Raw Data Example Table

Student I.D. Number	Lecturer code				
	19	27	17	21	18
149	54 .40	66 .55	47 .83	61 .91	43 .81
150	61.8 .21	59 .04	53 .43	49 -.26	61.5 .88
151	40 .32	49 .48	47 .21	17 .63	33 -.19
152	52.0 .14	51 .34	44 .39	31 .31	41 .94
153	82 .62	66 .75	64 .15	72 .48	56 .29
154	52.0 -.41	58 .31	47 .92	35 .64	77 .38

These figures were then converted to ranks, from which partial L values could be determined, (Figure 6.13).

Table 6.13

Ranked Data Example Table

Student I.D. Number	Lecturer Code 19	27	17	21	18	Partial L
149	3 5	1 4	4 2	2 1	5 3	44
150	1 3	3 4	4 2	5 5	2 1	35
151	2 3	3 2	1 4	5 1	4 5	41
152	1 5	2 3	3 2	5 4	4 1	41
153	1 2	3 1	4 5	1 3	5 4	51
154	3 5	2 4	4 1	5 2	1 3	40

The final value of L could then be determined by simply adding the Partial L values.

The tables for the SGO and SRO data have not been reproduced in full, as they contain far too much information to be comprehended. (Physics 201 tables have 462 entries, Physics 203 470 entries, and Physics 301 520 entries. If all tables were included, approximately 3,000 entries would need to be surveyed).

The values of L obtained by this method with each group are shown in Table 6.14.

Table 6.14

Page's L Values for SGO

Group	M	n	Page's L	Significance
Physics 201	33	7	3857	$\rho <$ .01
Physics 203	47	5	2196	$\rho <$ .01
Physics 301	20	13	13168	$\rho <$ .01

The null hypothesis is rejected in favour of the ordered hypothesis with the three groups that meet the statistical requirements.

6.3.2. The SRO Scales

H2 can be restated as:

H2 - Holding other variables constant, the greater the degree of similarity in Staff Role Orientation between a student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

and HS as

HS2- Given student achievement rankings Xij for student i with lecturer j, and lecturer/student SRO similarity rankings Yij, in any group where all m students have a common set of n courses then the statistic $L = \sum^{m} (\sum^{n} Xij\ Yij)$ will be significant at least at the 0.05 level.

To test the hypothesis, an identical procedure to that described in 6.3.2. was followed, however the similarity indices were on this occasion determined from the SRO scales. The results of this analysis are shown in Table 6.15.

Table 6.15

Page's L Values for SRO

Group	M	n	Page's L	Significance
Physics 201	33	7	3604	ns
Physics 203	47	5	2103	ns
Physics 301	20	13	12615	ns

In contrast to the SGO results, no significant values of L were obtained, and the ordered hypothesis must be rejected in favour of the null hypothesis.

6.4. After thought - a post hoc analysis

The result obtained with the SRO scales, coupled with the results described in Docking (1973), suggest that a second alternative hypothesis may be formulated.

H3 - Holding other variables constant, the greater the degree of dissimilarity in Staff Role Orientation between student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

A simple algebraic maniuplation enables a reverse L value to be determined from the L value of the original hypothesis.

$$L_R = \frac{mn}{2}(n + 1)^2 - L$$

The reverse L values are given in Table 6.16.

Table 6.16

Reverse L Values for SRO Scales

Group	M	n	L_R	Significance
Physics 201	33	7	3788	ns
Physics 203	47	5	2127	ns
Physics 301	20	13	12865	ns

While these values are higher, they still fail to achieve significance The reverse hypothesis, it appears, does not bear further research.

6.5. Summary

This chapter has described the implementation of the research design and instruments in a simple experiment. Assumptions upon which the design or analysis depended were first tested and substantiated, then the major hypotheses tested. In each case, the null hypothesis was rejected for the SGO scales, but in no case was this so for the SRO scales.

This chapter that follows will conclude the thesis with a discussion of these findings, and possible implications for further research.

CHAPTER 7

CONCLUSIONS

Before the implications of these results can be discussed, the internal and external validity (generalizability) of the study must be confirmed.

7.1. Limitations

The analysis of data described in Chapter 6 lead to the rejection of the null hypothesis in favour of the alternative hypothesis:

H2 - Holding other variables constant, the greater the degree of similarity in Student Goal Orientation between student and lecturer, the greater will be that student's achievement, as measured by that lecturer.

and, to the rejection of the alternative hypothesis in favour of the null hypothesis:

HO - Holding other variables constant, there is no relationship between similarity in Staff Role Orientation between student and lecturer and that student's achievement as measured by that lecturer.

What is the significance of these findings? Consider first the alternatives:

1. That both could be chance results. The possibility of this must be small, as such consistency was found with three independent groups, and in the case of the SGO scales at low levels of probability. The probability of such an event, if it were

indeed by chance would be less than .02 (2^{-6}), well below the levels of significance normally accepted in educational research (.05). It would appear, then, that the findings reflect 'reality' in some way.

2. That the SGO results are accurate, but the SRO results are in error. The support for this alternative lies in the lack of previous research and dimensional support for the SRO scales in contrast to the SGO scales, and the relatively poorer performance of the SRO scales (Chapter 5). This is quite a serious problem in the present research and cannot be dismissed. It appears that the SRO scales as measured do not reveal an important interaction process, but does that mean that no such interaction exists? Given that the SGO questionnaire has 'hit-the'target', have the SRO scales missed, or are there simply no other targets?

   A related alternative is that the SRO hypothesis is unsound. The *post-hoc* analysis does not support this theory, although evidence in Docking (1973) reporting on differences between year groups does. The trend away from staff on the SRO scales seems quite pronounced, but note two cautions:

   (i) the results are determined through aggregation of student scores, a procedure criticised earlier in this thesis; and

   (ii) the results were not obtained from a longitudinal study. Astin warns against such an approach:

> Many investigators use a variation of this basic design: instead of collecting longitudinal information they simply compare groups of freshmen and upperclassmen simultaneously on some measure. This method is so full of pitfalls, (many of which are discussed at length by Feldman and Newcomb) that one wonders if there is the slightest justification for supposing that the observed 'changes' are related in any way to the college experience. In addition to the problems already mentioned, this method carries with it potentially serious deficiencies in sampling. It rests on the assumptions that (a) upperclassmen are a representative sample - at least insofar as the output variable is concerned - of the total cohort of freshmen from which they are drawn, and (b) this original cohort was drawn from the same population as the current freshmen who are being compared with the upperclassmen.
>
> (Astin, 1970a, p.228).

With these points in mind, it seems that there is really very little if any evidence of a relationship between SRO congruence and achievement.

3. Both results reflect reality. In retrospect, this seems to be the most likely alternative. The data can be analysed another independent way that seems to suggest that these conclusions are valid. One analysis is reported in Docking (1973) in Appendix III and mentioned briefly in Chapter 5. The calculations conducted on SGO and SRO scores for year groups show that whilst students 'become' more like the majority of staff members over the three years on the SGO scales, they 'move' away from them on the SRO scales. This, as the paper suggests, could imply an anti-modelling effect. This possibility will be explored in a little more detail later in this chapter.

The result might also suggest other possibilities. Lecturers might not exhibit any role variations in their teaching that has an impact on students. Or, alternatively, if such a role image was projected, the students may not perceive it as important. The fact that a large group of students were teachers-in-training (40% bonded students) might mean that they would be insensitive to roles other than teaching.

4. It might be that while the effects observed were real enough, the 'causes' might not be. Can one attribute the variation in individual achievement to the congruency measure, or are some other variables operating? Earlier reported figures, mainly in Chapter 5, of correlations of the SGO and SRO scales with other factors suggest that they are largely independent of the 'traditional' variables such as intelligence, sex and age. Staff-student similarity is a compound variable, being formed from two independent sources (student and staff) and could not be reduced to a single simple variable, or related to two single variables (one student, one staff) of the more usual kind.

An alternative hypothesis might be that congruence is an outcome of achievement, rather than a'cause' of it. This seems an unlikely alternative, on two grounds:

(i) the second year students did not, in general, have identifiable previous experiences of achievement with each staff member; and

(ii) the effect was weaker in third year than in the second year. This is rather shaky evidence, as the samples may not be representative, nor are the statistical tests strictly comparable, but it is the reverse of the effect that this rival hypothesis would have.

Thus the caution expressed by Astin (1970a, p.144) quoted in Chapter 2, Section 5, does not appear to be applicable in this study.

An alternative approach to this question of meaningfulness is to consider Campbell and Stanley's (1963) eight criteria of internal validity, and four criteria of external validity. The experimental design of this study does not match any of Campbell and Stanley's, but in their terms it would be something like a counterbalanced design in which treatments were concurrent (Figure 7.1.).

repeated for all students in a year group

$$\begin{array}{cc} X_1 & O_1 \\ X_2 & O_2 \\ X_3 & O_3 \\ \vdots & \vdots \\ X_m & O_m \end{array}$$

where X_i represents the similarity between a student and lecturer i, and O_i represents the achievement score of that student commended by lecturer i.

Figure 7.1

Illustration of Experimental Design

The design is similar to the counterbalanced design in that 'experimental control is achieved or precision enhanced by entering all respondents (or settings) into all treatments'. (Campbell & Stanley, 1963, p.50). It differs, however, in that there is no time factor in the design. (Compare Figure 7.2 (1) with 7.2(b)).

	Time 1	Time 2	Time 3	Time 4
Group A	$X_1 O$	$X_2 O$	$X_3 O$	$X_4 O$
Group B	$X_2 O$	$X_4 O$	$X_1 O$	$X_3 O$
Group C	$X_3 O$	$X_1 O$	$X_4 O$	$X_2 O$
Group D	$X_4 O$	$X_3 O$	$X_2 O$	$X_1 O$

(a) Counterbalanced design (Campbell & Stanley, 1963,p.51).

Person A	$X_1X_2X_3\ldots X_n$	$O_1O_2O_3\ldots O_n$
Person B	$X_1X_2X_3\ldots X_n$	$O_1O_2O_3 \quad O_n$
'		
'		
'		
'		
Person M	$X_1X_2X_3\ldots X_n$	$O_1O_2O_3\ldots O_n$

(b) Design used in this study.

Figure 7.2.

Comparison of Designs

The time difference between the designs makes some major qualitative differences in validity. These are illustrated in Table 7.1.

It can be seen from this Table that the design utilised provides little cause for concern over the issue of internal or external validity, avoiding many of the concerns of the counterbalanced design. This allows one to generalize the findings to the target population - all Physics major students at the University. How much further can generalization be taken?

Table 7.1

Comparison of Validity Criteria

Criterion	Counterbalanced design (Campbell and Stanley, p.40)	Staff/Student Interaction Design
1. History	+	+ There are two controls of this extraneous variable. The first relates to the fact that all experiments occur simultaneously, the second to the fact that the criterion measure is a direct outcome of the experiment
2. Maturation	+	+ Apart from the argument given for History, which also applies here, the check of stability in Chapter 6 confirms the unimportance of this variable.
3. Testing	+	+ There were no pre-tests involved in the exercise, and the questionnaires are unlikely to have any effect on the criterion measures (See Chapter 5.)
4. Instrumentation	+	+ The instruments were demonstrated to be relatively insensitive to changes in administration, or scorers.
5. Statistical Regression	+	+ Persons not selected on extreme scores.
6. Selection	+	+ All students in all experiments.
7. Experimental Mortality	+	+ No differential loss. (Could only occur if some students dropped out of some but not all parts of the course).
8. Interactions of Pairs of Factors 1 to 7.	?	+ Not influenced by interactions between time, groups, treatments, etc.

Table 7.1 (Cont'd.)

Criterion	Counterbalanced design (Campbell and Stanley,p.40)	Staff/Student Interaction Design
9. Interaction of Testing and Treatment	?	+ Chapter 4 discusses this reactive effect in detail, concluding that there is little likelihood of such perturbation.
10. Interaction of Selection and Treatment	?	+ Selection not based on treatments, as all treatments offered simultaneously, and all students do all treatments.
11. Reactive Arrangements	?	+ Natural experiment, no creation of experimental setting.
12. Multiple Treatment Interference	-	? This can arise in two ways: interaction with other 'experiment' treatments, and where students take other non-physics courses (e.g. the qhysics 201 and 203 groups), interaction with 'non-experimental' treatments.

Generalization beyond Physics majors to other Physics students is relatively easy, as the selection of that target was to meet a statistical requirement (common subject sets).

Generalization beyond Physics students to Science students in general would also appear to be justifiable as the assessment techniques and content would be similar in form. However, the requirement of little feedback might be contravened, in which case the interaction effect may not be so evident.

Generalization beyond Science students to University students in general involves a number of assumptions that almost certainly must be violated. The unreliability of assessment in certain other fields would undoubtedly increase the error variance to a point where interaction effects would no longer be detectable. (They would still occur in the learning and assessing, but would no longer affect achievement so markedly). Courses of greater subjective content are likely to heighten the effect, but they are also less likely to be so dependent on the lecturer, and more likely to be based on other resources such as discussion groups and library sources. Whilst interaction effects are likely to occur over the short term, the student will have more opportunity to correct them, and the assessment procedure is less likely to reveal them.

The general conclusion of this study, then, may be stated in the following terms: In courses where there is little opportunity for staff-student informal communication and that are largely lecturer dependent, the quality of learning of a student (in terms of the lecturer's objectives for the student) is likely to be higher, the greater the similarity between the lecturer and student styles of intellectual functioning (as measured by the SGO scales).

In addition, in courses where the assessment procedure is relatively reliable, this variation in quality is likely to be evidenced in the student's performance as measured by that lecturer.

7.2. Implications for Further Research

As this study has developed and validated new instruments related to student and staff intellectual functioning, it represents the beginning of a line of potential research in a number of areas:

1. An initial task is replication - in different learning environments with different types of students.

2. A study of the external or behavioural indicators of intellectual style is warranted. This study has concentrated on the message decodes and encodes. Later studies need to relate these constructs to actual messages and their media.

3. Professional schools of study place great stress on modelling effects. The SRO findings case some doubt on the validity of such a concept, and need to be replicated in a Professional school.

4. The concept of a limited set of student or staff types based on these scales must be explored. Do the types suggested in Chapter 4 exist, and if so, what are their distinguishing characteristics?*.

5. How is personal bias injected into so-called 'objective' testing procedures? How can this be avoided.

---

* A preliminary study of this question has been indicated with the data used in this thesis. No clearly recognisable types were identified.

There are also the rather contraversial issues of student/lecturer matching, student selection, staff selection that could be considered.

The statistical techniques and research designs utklised in this study could have an impact on interaction studies in other areas and with other criteria - in fields of education, communication and linguistics.

7.3. Implications for Tertiary Teaching

The fact that some nebulous measure of intellectual style reveals an interaction effect that explains perturbations in individual achievement scores is hard to translate to the classroom situation. The following comments, therefore must be regarded as rather bold extrapolations from the findings of this study.

The difficulty of interpolation of findings such as these is recognised by Hunt, 1975, p.216:

> It is certainly true that understanding the needs of a student is not the same as specifying arrangements for meeting those needs, but this hardly justifies abandoning all efforts to understand individual students. We may know more than we can implement in the future, but this will depend not only on the state of knowledge but also on future systems of educational arrangements. It would seem most reasonable, therefore, to continue to try to gain some understanding of individual students and then to attempt to translate such knowledge into practice. Theories of implementing psychological ideas into educational practice require at least as much complexity as the psychological theories themselves,......

Is the effect observed desirable or undesirable? One's immediate reaction might be to lump this effect into the category of 'error' in measurement but it might serve a useful function.

Perhaps there are a limited set of cognitive structures suitable for successful professional physicists, and the interaction serves to 'weed out' those who do not fit. Lingitudinal evidence (from the three years tested) seems to support this, in that the students tend to be more like their lecturers on the SGO scales in later years (Docking, 1973). It seems that some form of selection, socialization or maturation is taking place. Stability measures described earlier suggest that the first of these processes is the most likely cause of the trend of growing similarity. Again, one must heed Astin's caution regarding data obtained concurrently from different year groups.

There seems to be, however, almost as much variety amongst the staff as amongst the students. It does not seem acceptable, then, to argue that 'best' intellectual styles can be identified. Furthermore, the set of styles represented by the staff may be limited to professional academics, whereas graduates from Physics are more likely to move into teaching or industry. On these grounds, it must be argued that the interaction is invalid, and from a learning point of view, undesirable.

The interaction effect can be eliminated in a number of ways, which have additional support on other grounds.

(1) Increase feedback opportunities. Recondiser the role of the lecture as a learning environment. Create learning environments where feedback is encouraged. Encourage informal out-of-class contact. Many other writers reach this conclusion from a number

of studies. Some are critical, such as Anderson:

> Other shortcomings in university pedagogy have been referred to: among these are the diminishing opportunities for 'feedback' from students to teacher. A further problem which concerns students indirectly is the difficulty, as a university increases in size, of maintaining adequate communication among staff members and between department or faculties. Often students are overloaded simply because there has not been an intelligent educational overview of the logical relation between the subjects comprising their course and of the arrangement in time of essays, assignments and tests.
> (Anderson, 1965, p.130)

others suggest solutions:

> Student faculty relationships outside of class are another cornerstone. They depend upon four major factors: accasibility, authenticity, knowledge, and the ability to talk with, not at, students.
> (Chickering, 1969, p.6).

and also

> ...students learn more than might be expected if they feel that instructors are readily accessible, interested in teaching, and interested in students as individuals.
> (Centra and Rock, 1971, p.633).

(2) Decrease the dependence on one lecturer. Use team teaching and multiple resources, including outside resources.

One such resource is the student body itself. If discussion is stimulated on academic matters much can be done to reduce misunderstandings.

> Students discuss work among themselves without staff members being present. Sometimes the discussion is informal and casual; occasionally there are well-organized groups which meet regularly and plan their activities. The value of student discussion groups is among the most overlooked educational resources in our universities. A student can improve his grasp of a subject in the act of communicating it to another, and the response of the listener is a check on the adequacy of understanding. In a survey of Melbourne first-year students, it was found that those who reported taking part in student-arranged discussions of work had better examination results than other students. The association is not necessarily casual, but our knowledge of how learning occurs suggests that discussion helps students to a better understanding of their work.
>
> (Anderson, 1965, p.142).

(3) Increase the specificity of course objectives and ensure assessment reflects them, rather than reflecting the lecturer's style of thinking.

(4) Use multiple examiners, both at the setting and the marking phases of tests.

(5) Use continuous testing, both as a form of feedback (item 1), and to increase the multiplicity of examiners.

(6) Encourage the discussion of bias and personal frame of reference, both by lecturer and student.

Would these measures effectively eliminate the interaction? The answer must be no - they would simply reduce its significance in a student's achievement. Could it be demonstrated that these measures would relieve such a reduction? This would be difficult, as many of the measures suggested are in violation of research design and statistical requirements.

The interaction effects in the traditional lecture-based course are quite real, however, the lecture approach is not without its support. After an extensive review of literature, McKeachie sums up as follows:

> What is the role of the lecturer in higher education? The research results we have cited provide little basis for an answer. They do not contradict - sometimes they support - our earlier notions the the lecture is an effective way of communicating information, particularly in classes where variations in student background, ability, or interest make feedback to the lecturer important. We have also seen that the organization and presentation of lectures may influence their effectiveness in teaching students how to apply knowledge or in influencing attitudes. However, a suspicion, supported by bits of evidence, arises that other methods of teaching may be more effective than lecturing in achieving some higher cognitive and attitudinal objectives.
> (McKeachie, 1965, p.1132).

In contrast the results of this study show that there are important effects that a lecturer must be aware of when teaching and testing students. These effects suggest that time spent on clarification of goals, sharing perceptions, and personal contact would be time well spent, as it would enable the development of mutual understanding of each participant's'frame of reference'. Team teaching, while not eliminating the effect, may reduce its impact on achievement, and hence appear fairer. Student choice of lecturer and examiner, or lecture technique and examination technique may be a solution, but the evidence to date suggests that they are likely to make unwise choices on inappropriate criteria (Rowell and Renner, 1975). Compulsory streaming into optimum technique/student groups may produce results (Domino, 1975) but could be a controversial practice on ethical grounds.

The SRO null result suggests that while the student respects and emulates the lecturer's ways and thinking, he does not identify with the person or his role.

In conclusion, the lack of opportunity for two-way communication in the lecture environment has subtle and undesirable side effects that surface in student achievement. The lecture situation is well known to be an inefficient learning environment for a range of objectives, and the evidence presented further invalidates its use. At a time when lecturing is still the standard teaching technique at tertiary level, further evidence of its specific weaknesses may serve to define sharper boundaries of its proper use in higher education.

Feldman and Newcomb describe the issue as follows:

> ...The more intellectually meaningful is the contact between students and faculty - both within and outside of the classroom - the more likely it is that the general student culture will be supportive of faculty goals. The structure of the formal educational program itself partially determines the meaningfulness of teacher-student contact. Without going into the relative merits for individual learning of such alternatives as lecture and examination versus small discussion classes, small classes versus large classes, content-oriented versus student-oriented instruction, the completely required curriculum versus various mixtures of requirements and electives, we emphasize Barton's (1960) proposition that 'the more student classroom roles consist of critical reading and active discussion of materials rather than passive listening and note-taking, the more likely it is that there will be productive intellectual discussion in informal peer groups'.
>
> (Feldman and Newcomb, 1969, p.267).

McKeachie has the last word (1961, p.139).

> What do these results add up to?
> To the obviously biased researcher, they add up to support for the original idea that teaching methods interact with student motives in determining the outcomes of education.

APPENDICES

APPENDIX I

QUESTIONNAIRES AND LETTERS

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MONASH UNIVERSITY

FACULTY OF EDUCATION

STAFF QUESTIONNAIRE

This questionnaire is part of a study of staff and students at tertiary institutions. The study is being conducted with the approval of the Chairman of the Department of Physics. This research was initiated by the observation that many students have misconceptions of the purpose of their education, one of the effects of which was a sense of alienation from the university and subsequent underachievement or failure. It is clear that the staff of a university play a vital role in the academic life of the students, and so any study that explores this problem must also pay attention to the views of the staff. The results of a project such as this may be of significance both to the students, in helping them to relate better to their lecturers, and to you, as a lecturer, in furthering your understanding of their needs and aspirations.

The questionnaire consists of three parts. In Part A you are asked to give some personal details. In Parts B and C you are asked to respond to a number of statements about a university education and the lecturer role, by selecting the appropriate response to each statement.

As it is necessary for the purposes of this study to be able to associate lecturers with their students,your name is requested. However, you can be assured that your answers will be held in strictest confidence. No information will be released that will allow individual lecturers to be identified. The information will be used in a statistical manner, and will not be made available to the Faculty, the University, or any other persons or organizations.

The method of answering most questions is self explanatory. Directions are given at the beginning of Parts B and C. You are asked to try to complete the questionnaire at one sitting. The whole questionnaire should take you no more than fifteen minutes to complete.

When you have completed the questionnaire, it may be returned to me through the internal mail in the envelope attached. I would greatly appreciate it if you could return this before July.

If you have any queries about the questionnaire, please contact me as soon as possible (ext. 2869) and I shall be glad to discuss them with you.

Russell A. Docking
Research Scholar
Faculty of Education

PART A

1. **Name:** Surname ______________________________ Initials: __________
(BLOCK LETTERS)

2. **Age:** __________ years.

3. **Experience:**

Years of experience in positions other than, but related to, your present position at this University.

(Research or teaching in physics.)

__________ **years.**

NOW GO ON TO PART B

Office use only:

4.	P	☐
5.	HPQ	☐
6.	NPQ	☐
7.	NOQ	☐
8.	UT1	☐
9.	UT2	☐
10.	UT3	☐
11.	T	☐
12.	R	☐
13.	A	☐
14.	V	☐
15.	B	☐
16.	E	☐
17.	Au	☐
18.	SRO	☐
19.	SGO	☐

PART B

There is evidence showing that staff and students differ in their perception of the purpose of a university education. In this section, you are asked to indicate what you consider to be the *perception* a student in your Faculty *should have* of the goals and activities of a university, by circling:

	SA	if you strongly agree with the statement
	A	if you agree with the statement
	D	if you disagree with the statement
or	SD	if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND ANSWER AS QUICKLY AS YOU CAN.

1. Great emphasis should be placed on providing facilities for sports and social activities at universities. SD D A SA

2. A university education should develop a lively intellectual interest in a wide range of topics. SD D A SA

3. Universities should assess students in as many different ways as possible. SD D A SA

4. Universities should employ lecturers who stimulate students to think deeply in their subjects. SD D A SA

5. Tertiary education should provide a specialised understanding of one field of knowledge. SD D A SA

6. Assessment is contrary to the ideals of a university. SD D A SA

7. The university should insist that *all* students engage in some non-intellectual activities. SD D A SA

8. Tertiary education should serve to widen one's intellectual experience. SD D A SA

9. Examiners should keep in mind the individual needs of each student in setting and marking examination papers. SD D A SA

10. Tertiary education should encourage students to think in depth. SD D A SA

11. A university education should train students to become adept in a narrow field. SD D A SA

12. The failing or passing of an examination is not as important as the learning that preceded it. SD D A SA

13. Lecturers should clearly indicate what are the *minimal* requirements for a pass. SD D A SA

14. A university education should aim to develop in the individual a personal philosophy of life. SD D A SA

15. An examination is necessary so that one can prove to others that one is qualified. SD D A SA

16. The working year is too short at this university. SD D A SA

17. It is not the purpose of a university to encourage freedom of thought. SD D A SA

18. You should set your own goals and standards - no one else can do it for you. SD D A SA

19. It is easy to adjust to different teaching styles. SD D A SA

20. Universities should employ lecturers who can get the maximum number of people up to examination standard with the minimum of student labour. SD D A SA

21. A university education should help one develop an understanding of world issues. SD D A SA

22. Assessment is necessary if standards are to be maintained. SD D A SA

23. It is difficult to adjust to new surroundings and ideas. SD D A SA

24. Universities should provide facilities for students to engage in extensive study. SD D A SA

25. Tertiary institutions should provide an environment where a student's special interest can be nurtured. SD D A SA

26. Formal examinations should not be used at universities. SD D A SA

27. When lecturers have different views of a university education students become confused about what to learn. SD D A SA

28. These are the best years of your life and should not be wasted on study. SD D A SA

29. Tertiary education should emphasise a deep involvement with ideas, whether scientific or humanistic. SD D A SA

30. Examinations provide the opportunity for one to gain recognition for one's efforts. SD D A SA

31. I have a clear educational goal that I am determined to attain. SD D A SA

32. A university education should serve to develop the intellect. SD D A SA

33. The establishment of departmental libraries, containing only texts directly related to one area of specialisation, is preferable to larger multi-disciplinary libraries. SD D A SA

34. Examinations distort the true purpose of tertiary education - learning for it's own sake. SD D A SA

35. You would do better if you held the same views as your lecturers. SD D A SA

NOW GO ON TO PART C

PART C

There is evidence to suggest that students and staff differ in their ideas as to the role of academic staff at universities. The items on the following pages describe various attitudes that a staff member may have to his work at the university. Please read each statement carefully and indicate whether you think the attitude described is a desirable one for an academic staff member to hold, by circling:

	SA	if you strongly agree with the statement
	A	if you agree with the statement
	D	if you disagree with the statement
or	SD	if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND

ANSWER AS QUICKLY AS YOU CAN.

It is desirable that a lecturer should:

1.	Participate in the *organisation* of activities outside his particular field of interest.	SD	D	A	SA
2.	Be able to speak to the students at their level and be conversant with their culture.	SD	D	A	SA
3.	Be given a sufficiently light student-contact load, so that demanding research projects can be carried out.	SD	D	A	SA
4.	Be critical of current institutional practices in teaching, research, and other activities.	SD	D	A	SA
5.	Not encourage students to join professional associations.	SD	D	A	SA
6.	Not encourage students to participate in research projects.	SD	D	A	SA
7.	Be prepared to act as a spokesman for the university or Faculty.	SD	D	A	SA
8.	Know something of the future plans of individual students.	SD	D	A	SA
9.	Be encouraged to keep up with the latest developments in his field by practical means such as study leave.	SD	D	A	SA
10.	Avoid involvement in course administration tasks (such as time-tabling).	SD	D	A	SA
11.	Not be disturbed by students while in his office.	SD	D	A	SA
12.	Avoid the temptation of setting aside most of his time for conducting research.	SD	D	A	SA
13.	Insist that his status as a staff member be recognised.	SD	D	A	SA
14.	Be willing to go to the administration on behalf of the students.	SD	D	A	SA
15.	Be encouraged to publish reports in recognised journals.	SD	D	A	SA
16.	Be involved in activities outside the institution and away from students.	SD	D	A	SA

It is desirable that a lecturer should:

17. Avoid discussion of political and social issues with students. SD D A SA

18. Be selected on the basis of teaching or administrative ability, rather than ability in research. SD D A SA

19. Be able to teach and examine in any way he chooses. SD D A SA

20. Participate in policy-making committees. SD D A SA

21. Encourage students to adopt radical views about religion, politics or morality. SD D A SA

22. Be a well known authority in his field. SD D A SA

23. Be able to select the content matter of courses, free from direction by others in the faculty or university. SD D A SA

24. Refuse promotion that inevitably leads to a purely administrative position. SD D A SA

25. Avoid becoming involved with the individual student's personal problems. SD D A SA

26. Consider research opportunity as a privilege and not a right. SD D A SA

27. Act on the comments of students about courses. SD D A SA

28. Participate in the administration of student disciplinary measures. SD D A SA

29. Be patient with students who stress their own individuality. SD D A SA

30. Have considerable ability in carrying out research. SD D A SA

31. Strive to maintain a good public image of the university. SD D A SA

32. Avoid involvement in administrative matters. SD D A SA

33. Treat students as subordinates rather than as equals. SD D A SA

34. Confine his lectures to the text, avoiding references to recent research findings in the area. SD D A SA

35. Be prepared to assess the effectiveness of his teaching techniques. SD D A SA

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: *Monashuni Melbourne*

FACULTY OF EDUCATION
DEAN: *Professor S. S. Dunn*

Dear

I am conducting research into problems of students at university, particularly in the Physics Department. Part of this study requires the completion of a questionnaire by all staff members in the department.

I am endeavouring to give the questionnaire personally to each staff member during the week starting June 12th.

I have been unable to contact you in person, but would be most grateful if you would accept this questionnaire by mail.

If you would like to discuss the questionnaire further, please contact me on extension 2869.

Yours sincerely,

(Russell Docking)
Research Scholar

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: *Monashuni Melbourne*

FACULTY OF EDUCATION
DEAN: *Professor S. S. Dunn*

Dear

I appreciate the assistance you have given me with my study of staff and students in the Physics Department, through the return of the staff questionnaire.

I hope that the results justify the amount of time and effort you have put into responding to the questionnaire.

Yours sincerely,

(Russell Docking)
Research Scholar

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: *Monashuni Melbourne*

ULTY OF EDUCATION
Professor S. S. Dunn

Dear

Some time ago I asked you to complete a questionnaire as part of a study of staff-student interaction. To date most staff members have replied to the questionnaire. However, I note that I have not as yet received your reply, and I would be grateful if you could attend to this as soon as possible.

If you have mislaid the questionnaire, or are not happy with the way questions are asked, I would be pleased to assist. In the latter case I would be prepared to replace the questionnaire with an interview should you prefer. In either case, please contact me at extension 2869, and I shall be happy to make the appropriate arrangements.

I cannot over emphasise that every response is of great importance to this study. Further, I want to assure you that this study is in no way intended to evaluate staff individually or the Department as a whole. Its sole purpose is to determine whether characteristic orientation patterns of staff and students interact to effect student achievement in Physics. I would be glad to discuss the aims of the study and any other details with you if you are interested.

Yours sincerely,

Russell Docking,
(Research Scholar)

MONASH UNIVERSITY
FACULTY OF EDUCATION

STUDENT QUESTIONNAIRE

This questionnaire is part of a study of staff and students at tertiary institutions. The study is being conducted with the approval of the Chairman of the Physics Department, and your lecturers. This research was initiated by the observation that students often feel misunderstood, or that their individual needs and interests are not recognised by their lecturers. The breakdown in communication between staff and students can often have detrimental effects on interest and performance in subjects, that may result in failure. This study then, in seeking areas of communication breakdown, may have far reaching effects for students in the future, even for you in later years. For this reason I ask you to approach this questionnaire seriously, and answer as best you can.

The questionnaire consists of four parts. In Part A you are asked to give some personal details, such as your name, course and age. In Parts B and C you are asked to respond to a number of statements about a university education and lecturers, by selecting the appropriate response to each. In Part D you are asked to identify important sources of influence in the development of your ideas, by selecting influences from a given list.

As it is necessary for the purposes of this study to be able to incorporate performance in examinations, your name and number are required. These will be replaced by another number for analysis by computer, and once the data has been transferred to computer cards the questionnaires will be destroyed. However, as there still remains the possibility of being identified, you can be assured that your answers will be held in strictest confidence. No information will be released that will allow individual students to be identified. The information will be used in a statistical manner, and will not be made available to any staff in your Faculty, the University, or any other persons or organizations.

The method of answering most questions is self explanatory. Directions are given for each item where necessary (in Part A) and at the beginning of Parts B, C, and D. Although there is no time limit on the questionnaire, the whole questionnaire should take you no more than twenty five minutes to complete, if you answer as quickly as you can.

When you have completed the questionnaire, check that you have answered *every* question, and, in Parts B and C, that you have given only *one* answer for each question. I, or an assistant, will collect the questionnaire when you have fully completed it.

Mr. R.A. Docking
Research Scholar
Faculty of Education
Monash University

PART A

1. Name: Surname: ____________________ (BLOCK LETTERS) Other names: ____________________ (BLOCK LETTERS)

2. Number: ☐☐☐☐☐☐☐

3. Course: *(Tick appropriate box)*

- 1\. Physics 101 ☐
- 2\. Physics 201 ☐
- 3\. Physics 203 ☐
- 4\. Physics 301 ☐
- 5\. Physics 303 ☐

4. Age: ______ years ______ months

5. Sex: *(Tick appropriate box)*

- 1\. Male ☐
- 2\. Female ☐

6. Scholarship: *(Tick appropriate box)*

- 1\. None ☐
- 2\. Commonwealth ☐
- 3\. Other non-bonded ☐
- 4\. Education Department ☐
- 5\. Other bonded ☐

7. Occupation of the head of your family:

Describe the present or last *main occupation* of the head of your family. (Father, or guardian, etc.) State both *grade* and *nature* of occupation.

eg. Senior clerk in bank.
Large farm owner, supervises work on own land.
Owner of business, valued at about $40,000.
Plumber on wages.
Sales manager, large business.

Please do not use general terms such as Civil Servant, clerk, teacher, engineer, proprietor, manager, without further specification.

____

____

____________________ Office use only: ☐ ☐

8. Planned studies beyond completion of degree.
(Tick appropriate box(es).)

1. Do not intend to complete degree. ☐
2. Honours without higher degree. ☐
3. Higher degree (Master or Doctor) ☐
4. Diploma in Education. ☐
5. Other Diploma. (Specify: ____________________) ☐
6. Another Degree. (Specify) ____________________) ☐
7. Other studies. (Specify: ____________________) ☐
8. No further studies planned. ☐

9. Residence during semester:
(Tick appropriate box.)

1. Home with parents. ☐
2. Affiliated hall of residence. ☐
3. University hall of residence. ☐
4. Boarding with friends or relatives. ☐
5. Shared flat or house. ☐
6. Own flat or house. ☐

NOW GO ON TO PART B

Office use only:	10	HA	☐
	11	HP	☐
	12	FP	☐
	13	SP	☐
	14	V	☐
	15	B	☐
	16	E	☐
	17	T	☐
	17	R	☐
	19	A	☐
	20	F	☐
	21	SGO	☐
	22	SRO	☐
	23	U1R	☐
	24	U2R	☐
	25	U3R	☐
	26	U4R	☐
	27	U5R	☐
	28	U6R	☐

PART B

At this stage of your education you will have developed some opinions about the purpose of a university education, and about some aspects of this university in particular. On the following pages are statements which describe the way students may see this university or the purposes of your education here. Please read each statement carefully and then respond to it by circling:

SA if you strongly agree with the statement

A if you agree with the statement

D if you disagree with the statement

or SD if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND

ANSWER AS QUICKLY AS YOU CAN.

1. Great emphasis should be placed on providing facilities for sports and social activities at universities. SD D A SA
2. A university education should develop a lively intellectual interest in a wide range of topics. SD D A SA
3. Universities should assess students in as many different ways as possible. SD D A SA
4. Universities should employ lecturers who stimulate students to think deeply in their subjects. SD D A SA
5. Tertiary education should provide a specialised understanding of one field of knowledge. SD D A SA
6. Assessment is contrary to the ideals of a university. SD D A SA
7. The university should insist that *all* students engage in some non-intellectual activities. SD D A SA
8. Tertiary education should serve to widen one's intellectual experience. SD D A SA
9. Examiners should keep in mind the individual needs of each student in setting and marking examination papers. SD D A SA
10. Tertiary education should encourage students to think in depth. SD D A SA
11. A university education should train students to become adept in a narrow field. SD D A SA
12. The failing or passing of an examination is not as important as the learning that preceded it. SD D A SA
13. Lecturers should clearly indicate what are the *minimal* requirements for a pass. SD D A SA
14. A university education should aim to develop in the individual a personal philosophy of life. SD D A SA

15. An examination is necessary so that one can prove to others that one is qualified. SD D A SA

16. The working year is too short at this university. SD D A SA

17. It is not the purpose of a university to encourage freedom of thought. SD D A SA

18. You should set your own goals and standards - no one else can do it for you. SD D A SA

19. It is easy to adjust to different teaching styles. SD D A SA

20. Universities should employ lecturers who can get the maximum number of people up to examination standard with the minimum of student labour. SD D A SA

21. A university education should help one develop an understanding of world issues. SD D A SA

22. Assessment is necessary if standards are to be maintained. SD D A SA

23. It is difficult to adjust to new surroundings and ideas. SD D A SA

24. Universities should provide facilities for students to engage in extensive study. SD D A SA

25. Tertiary institutions should provide an environment where a student's special interest can be nurtured. SD D A SA

26. Formal examinations should not be used at universities. SD D A SA

27. When lecturers have different views of a university education students become confused about what to learn. SD D A SA

28. These are the best years of your life and should not be wasted on study. SD D A SA

29. Tertiary education should emphasise a deep involvement with ideas, whether scientific or humanistic. SD D A SA

30. Examinations provide the opportunity for one to gain recognition for one's efforts. SD D A SA

31. I have a clear educational goal that I am determined to attain. SD D A SA

32. A university education should serve to develop the intellect. SD D A SA

33. The establishment of departmental libraries, containing only texts directly related to one area of specialisation, is preferable to larger multi-disciplinary libraries. SD D A SA

34. Examinations distort the true purpose of tertiary education - learning for it's own sake. SD D A SA

35. You would do better if you held the same views as your lecturers. SD D A SA

NOW GO ON TO PART C

PART C

You will also probably have some very definite views on what constitutes a good lecture or lecturer. The items on the following pages describe various attitudes that a staff member may have to his work at the university. Please read each statement carefully and indicate whether you think the attitude described is a desirable one for a lecturer (or an academic staff member) to hold, by circling:

	SA	if you strongly agree with the statement
	A	if you agree with the statement
	D	if you disagree with the statement
or	SD	if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND
ANSWER AS QUICKLY AS YOU CAN.

It is desirable that a lecturer should:

1. Participate in the *organisation* of activities outside his particular field of interest. SD D A SA

2. Be able to speak to the students at their level and be conversant with their culture. SD D A SA

3. Be given a sufficiently light student-contact load, so that demanding research projects can be carried out. SD D A SA

4. Be critical of current institutional practices in teaching, research, and other activities. SD D A SA

5. Not encourage students to join professional associations. SD D A SA

6. Not encourage students to participate in research projects. SD D A SA

7. Be prepared to act as a spokesman for the university or Faculty. SD D A SA

8. Know something of the future plans of individual students. SD D A SA

9. Be encouraged to keep up with the latest developments in his field by practical means such as study leave. SD D A SA

0. Avoid involvement in course administration tasks (such as time-tabling). SD D A SA

1. Not be disturbed by students while in his office. SD D A SA

2. Avoid the temptation of setting aside most of his time for conducting research. SD D A SA

3. Insist that his status as a staff member be recognised. SD D A SA

4. Be willing to go to the administration on behalf of the students. SD D A SA

5. Be encouraged to publish reports in recognised journals. SD D A SA

6. Be involved in activities outside the institution and away from students. SD D A SA

It is desirable that a lecturer should:

17. Avoid discussion of political and social issues with students. SD D A SA

18. Be selected on the basis of teaching or administrative ability, rather than ability in research. SD D A SA

19. Be able to teach and examine in any way he chooses. SD D A SA

20. Participate in policy-making committees. SD D A SA

21. Encourage students to adopt radical views about religion, politics or morality. SD D A SA

22. Be a well known authority in his field. SD D A SA

23. Be able to select the content matter of courses, free from direction by others in the faculty or university. SD D A SA

24. Refuse promotion that inevitably leads to a purely administrative position. SD D A SA

25. Avoid becoming involved with the individual student's personal problems. SD D A SA

26. Consider research opportunity as a privilege and not a right. SD D A SA

27. Act on the comments of students about courses. SD D A SA

28. Participate in the administration of student disciplinary measures. SD D A SA

29. Be patient with students who stress their own individuality. SD D A SA

30. Have considerable ability in carrying out research. SD D A SA

31. Strive to maintain a good public image of the university. SD D A SA

32. Avoid involvement in administrative matters. SD D A SA

33. Treat students as subordinates rather than as equals. SD D A SA

34. Confine his lectures to the text, avoiding references to recent research findings in the area. SD D A SA

35. Be prepared to assess the effectiveness of his teaching techniques. SD D A SA

PART D

Throughout this questionnaire you have expressed your views about many different aspects of tertiary education and this university. No doubt you formed most of these impressions on your own, but other people will have influenced you.

Below is a list of fifteen different types of persons or groups who may have influenced you in the development of your opinions.

Before continuing, read through the list carefully.

Code number	Person or group
1.	Parents.
2.	Your lecturers as a group.
3.	Organisations outside the university. (Church, social or sporting.)
4.	Later year students, in the same course.
5.	A school or university counsellor.
6.	Non-tertiary peers (the wider group of your friends not attending a tertiary institution.)
7.	A particular lecturer.
8.	Demonstrators or tutors.
9.	School teacher(s).
10.	Relatives (Not immediate family.)
11.	One of your closest three friends.
12.	Brothers and/or sisters.
13.	University publications. (Student paper etc.)
14.	Tertiary peers (the wider group of your friends attending a tertiary instituion, not including group 4.)
15.	University clubs or societies. (Sporting, cultural etc.)

In the following questions, you are asked to choose, in order, the two most important persons or groups who have influenced you in the formation of your opinions. (APART FROM YOURSELF)

Who have been the two most important influences:

1. in the development of your attitudes to this university	(1)	1st	2nd
2. in the development of your attitudes to your studies in general	(2)	1st	2nd
3. in the development of your attitudes to Physics studies in particular	(3)	1st	2nd
4. on your choice of course for this year	(4)	1st	2nd
5. on your choice of course for next year	(5)	1st	2nd
6. in the development of your attitudes to your lecturers as a group.	(6)	1st	2nd

THANK YOU FOR YOUR CO-OPERATION

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: *Monashuni Melbourne*

ULTY OF EDUCATION
Professor S. S. Dunn

23rd June 1972.

Dear

Over the past week I have been administering questionnaires to students taking physics (or who were taking physics) at this University. Unfortunately, I have not been able to contact you, and so I am sending you a questionnaire with this letter.

The questionnaire is designed to measure the attitudes of students, in order that a study of staff - student interaction can be made. (Staff are also completing a questionnaire.) A more complete discussion of the questionnaire is given on its first page.

You may have very definite views about the University and lecturers, and this questionnaire provides a means by which you can confidentially and effectively express those views.

I would like you to complete the questionnaire and return it to me in the post-paid envelope provided, as soon as possible.

Thank you for your assistance,

R. Docking
(R.A. Docking)
Research Scholar

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: Monashuni Melbourne

ULTY OF EDUCATION
: Professor S. S. Dunn

23rd June, 1972.

Dear

I would like to take this opportunity to thank you for completing the questionnaire I gave you last week. I feel confident that a great deal of valuable information will ensue from your contribution and the contribution of your colleagues.

You have been chosen to assist me in one further step - a test of the stability of the questionnaires. In order to measure this, people who have completed one questionnaire are asked to complete another. I would appreciate it, therefore, if you would fill out the questionnaire enclosed and return it to me in the post-paid envelope as soon as possible.

Thank you for your assistance,

(R.A. Docking)
Research Scholar

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: Monashuni Melbourne

ULTY OF EDUCATION
: Professor S. S. Dunn

5th July, 1972.

Dear

A short time ago I sent you a copy of a questionnaire concerning staff and students at university. To date, the response from students and staff have been exceptionally good, but I note that I have not yet received your reply.

You may have mislaid the questionnaire, or you may have uncertainties concerning its completion. If the latter is the case, I would like to reiterate a number of points concerning the questionnaire.

Every reply is important to the study. Your views will not be lost in a mass of averages or percentages - they are important in their own right, even if you have discontinued your studies. Your replies shall be held in strict confidence. However, should you be unhappy about giving your number or your name, either or both may be left out. An anonymous questionnaire is still of considerable value.

I appreciate that the questionnaire may come at a busy time for you, but I would urge you to put aside a little time to complete it, before Monday 10th July. A second copy of the questionnaire and a post-paid envelope are enclosed for your reply.

Thank you for your assistance,

(R.A. Docking)
Research Scholar

MONASH UNIVERSITY

FACULTY OF EDUCATION

STUDENT QUESTIONNAIRE

PART A

Office use only: 1. Identification no.

2	V	
3	B	
4	E	
5	F	
6	T	
7	R	
8	A	
9	AU	
10	SGO	
11	SRO	

GO ON TO PART B

PART B

At this stage of your education you will have developed some opinions about the purpose of a university education, and about some aspects of this university in particular. On the following pages are statements which describe the way students may see this university or the purposes of your education here. Please read each statement carefully and then respond to it by circling:

SA if you strongly agree with the statement

A if you agree with the statement

D if you disagree with the statement

or SD if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND

ANSWER AS QUICKLY AS YOU CAN.

1. Great emphasis should be placed on providing facilities for sports and social activities at universities. SD D A SA

2. A university education should develop a lively intellectual interest in a wide range of topics. SD D A SA

3. Universities should assess students in as many different ways as possible. SD D A SA

4. Universities should employ lecturers who stimulate students to think deeply in their subjects. SD D A SA

5. Tertiary education should provide a specialised understanding of one field of knowledge. SD D A SA

6. Assessment is contrary to the ideals of a university. SD D A SA

7. The university should insist that *all* students engage in some non-intellectual activities. SD D A SA

8. Tertiary education should serve to widen one's intellectual experience. SD D A SA

9. Examiners should keep in mind the individual needs of each student in setting and marking examination papers. SD D A SA

10. Tertiary education should encourage students to think in depth. SD D A SA

11. A university education should train students to become adept in a narrow field. SD D A SA

12. The failing or passing of an examination is not as important as the learning that preceded it. SD D A SA

13. Lecturers should clearly indicate what are the *minimal* requirements for a pass. SD D A SA

14. A university education should aim to develop in the individual a personal philosophy of life. SD D A SA

15. An examination is necessary so that one can prove to others that one is qualified. SD D A SA

16. The working year is too short at this university. SD D A SA

17. It is not the purpose of a university to encourage freedom of thought. SD D A SA

18. You should set your own goals and standards - no one else can do it for you. SD D A SA

19. It is easy to adjust to different teaching styles. SD D A SA

20. Universities should employ lecturers who can get the maximum number of people up to examination standard with the minimum of student labour. SD D A SA

21. A university education should help one develop an understanding of world issues. SD D A SA

22. Assessment is necessary if standards are to be maintained. SD D A SA

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25. Tertiary institutions should provide an environment where a student's special interest can be nurtured. SD D A SA

26. Formal examinations should not be used at universities. SD D A SA

27. When lecturers have different views of a university education students become confused about what to learn. SD D A SA

28. These are the best years of your life and should not be wasted on study. SD D A SA

29. Tertiary education should emphasise a deep involvement with ideas, whether scientific or humanistic. SD D A SA

30. Examinations provide the opportunity for one to gain recognition for one's efforts. SD D A SA

31. I have a clear educational goal that I am determined to attain. SD D A SA

32. A university education should serve to develop the intellect. SD D A SA

33. The establishment of departmental libraries, containing only texts directly related to one area of specialisation, is preferable to larger multi-disciplinary libraries. SD D A SA

34. Examinations distort the true purpose of tertiary education - learning for it's own sake. SD D A SA

35. You would do better if you held the same views as your lecturers. SD D A SA

NOW GO ON TO PART C

PART C

You will also probably have some very definite views on what constitutes a good lecture or lecturer. The items on the following pages describe various attitudes that a staff member may have to his work at the university. Please read each statement carefully and indicate whether you think the attitude described is a desirable one for a lecturer (or an academic staff member) to hold, by circling:

	SA	if you strongly agree with the statement
	A	if you agree with the statement
	D	if you disagree with the statement
or	SD	if you strongly disagree with the statement.

If you change your mind about an answer, just cross it out and circle another one.

PLEASE GIVE A RESPONSE TO EVERY STATEMENT, AND

ANSWER AS QUICKLY AS YOU CAN.

It is desirable that a lecturer should:

1. Participate in the *organisation* of activities outside his particular field of interest.	SD	D	A	SA
2. Be able to speak to the students at their level and be conversant with their culture.	SD	D	A	SA
3. Be given a sufficiently light student-contact load, so that demanding research projects can be carried out.	SD	D	A	SA
4. Be critical of current institutional practices in teaching, research, and other activities.	SD	D	A	SA
5. Not encourage students to join professional associations.	SD	D	A	SA
6. Not encourage students to participate in research projects.	SD	D	A	SA
7. Be prepared to act as a spokesman for the university or Faculty.	SD	D	A	SA
8. Know something of the future plans of individual students.	SD	D	A	SA
9. Be encouraged to keep up with the latest developments in his field by practical means such as study leave.	SD	D	A	SA
10. Avoid involvement in course administration tasks (such as time-tabling).	SD	D	A	SA
11. Not be disturbed by students while in his office.	SD	D	A	SA
12. Avoid the temptation of setting aside most of his time for conducting research.	SD	D	A	SA
13. Insist that his status as a staff member be recognised.	SD	D	A	SA
14. Be willing to go to the administration on behalf of the students.	SD	D	A	SA
15. Be encouraged to publish reports in recognised journals.	SD	D	A	SA
16. Be involved in activities outside the institution and away from students.	SD	D	A	SA

It is desirable that a lecturer should:

17. Avoid discussion of political and social issues with students. SD D A SA

18. Be selected on the basis of teaching or administrative ability, rather than ability in research. SD D A SA

19. Be able to teach and examine in any way he chooses. SD D A SA

20. Participate in policy-making committees. SD D A SA

21. Encourage students to adopt radical views about religion, politics or morality. SD D A SA

22. Be a well known authority in his field. SD D A SA

23. Be able to select the content matter of courses, free from direction by others in the faculty or university. SD D A SA

24. Refuse promotion that inevitably leads to a purely administrative position. SD D A SA

25. Avoid becoming involved with the individual student's personal problems. SD D A SA

26. Consider research opportunity as a privilege and not a right. SD D A SA

27. Act on the comments of students about courses. SD D A SA

28. Participate in the administration of student disciplinary measures. SD D A SA

29. Be patient with students who stress their own individuality. SD D A SA

30. Have considerable ability in carrying out research. SD D A SA

31. Strive to maintain a good public image of the university. SD D A SA

32. Avoid involvement in administrative matters. SD D A SA

33. Treat students as subordinates rather than as equals. SD D A SA

34. Confine his lectures to the text, avoiding references to recent research findings in the area. SD D A SA

35. Be prepared to assess the effectiveness of his teaching techniques. SD D A SA

PART D

Throughout this questionnaire you have expressed your views about many different aspects of tertiary education and this university. No doubt you formed most of these impressions on your own, but other people will have influenced you.

Below is a list of fifteen different types of persons or groups who may have influenced you in the development of your opinions.

Before continuing, read through the list carefully.

Code number	Person or group
1.	Parents.
2.	Your lecturers as a group.
3.	Organisations outside the university. (Church, social or sporting.)
4.	Later year students, in the same course.
5.	A school or university counsellor.
6.	Non-tertiary peers (the wider group of your friends not attending a tertiary institution.)
7.	A particular lecturer.
8.	Demonstrators or tutors.
9.	School teacher(s).
10.	Relatives (Not immediate family.)
11.	One of your closest three friends.
12.	Brothers and/or sisters.
13.	University publications. (Student paper etc.)
14.	Tertiary peers (the wider group of your friends attending a tertiary instituion, not including group 4.)
15.	University clubs or societies. (Sporting, cultural etc.)

In the following questions, you are asked to choose, in order, the two most important persons or groups who have influenced you in the formation of your opinions. (APART FROM YOURSELF)

Who have been the two most important influences:

1. in the development of your attitudes to this university	(1)	1st	2nd
2. in the development of your attitudes to your studies in general	(2)	1st	2nd
3. in the development of your attitudes to Physics studies in particular	(3)	1st	2nd
4. on your choice of course for this year	(4)	1st	2nd
5. on your choice of course for next year	(5)	1st	2nd
6. in the development of your attitudes to your lecturers as a group.	(6)	1st	2nd

THANK YOU FOR YOUR CO-OPERATION

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: *Monashuni Melbourne*

ULTY OF EDUCATION
: *Professor S. S. Dunn*

16th October, 1972.

Late last semester you completed a questionnaire for me about tertiary education and lecturers at universities. Your answers have been partially analysed and are most encouraging. I have now reached the final stage of my study and again I ask you to assist me with it by the completion of the questionnaire enclosed. The questionnaire has been mailed to you so that class time will not be taken up, and so you can complete the questionnaire at your leisure. I ask you to fill it in now, as the study requires that it be completed as close as practicable to the time of the examinations. To remind you of the purposes of the study, I reiterate some of the comments on the introductory page of the first questionnaire.

> This questionnaire is part of a study of staff and students at tertiary institutions. The study is being conducted with the approval of the Chairman of the Physics Department, and your lecturers. This research was initiated by the observation that students often feel misunderstood, or that their individual needs and interests are not recognised by their lecturers. The breakdown in communication between staff and students can often have detrimental effects on interest and performance in subjects, that may result in failure. This study, then, in seeking areas of communication breakdown, may have far reaching effects for students in the future, even for you in later years. For this reason I ask you to approach this questionnaire seriously, and answer as best you can.

The questionnaire consists of four parts. Part A does not require any responses from you. However, I would like to draw your attention to the identification number on the front. This arrangement enables me to add your answers from this questionnaire to the information from your first questionnaire. At the same time it guarantees anonymity should your reply go astray in the return post. Although these steps have been taken it is necessary for me to further assure you that no information will be released that will allow individual students to be identified. The information will be used in a statistical manner, and will not be made available to any staff in your Faculty, the University, or any other persons or organisations.

In Parts B and C you are asked to respond to a number of statements about a university education and lecturers, by selecting the appropriate response to each. In Part D you are asked to identify important sources of influence in the development of your ideas, by selecting influences from a given list.

Although there is no time limit on the questionnaire, the whole questionnaire should take you no more than fifteen minutes to complete, if you answer as quickly as you can.

When you have completed the questionnaire, check that you have answered *every* question, and, in Parts B and C, that you have given only *one* answer for each question. You are asked to complete the questionnaire and return it in the post-paid envelope enclosed before *next Friday* (20th October) so that non-respondents can be followed up before the examinations commence.

Thank you for your assistance.

Russell Docking
Research Scholar
Faculty of Education
Monash University
(544 0811, ext. 2869)

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: Monashuni Melbourne

ULTY OF EDUCATION
Professor S. S. Dunn

October, 1972.

Dear

I appreciate the assistance you have given me with my study of staff and students in the Physics Department, through the return of the student questionnaire.

I hope that the results justify the amount of time and effort you have put into responding to the questionnaire.

Yours sincerely,

(Russell Docking)
Research Scholar

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: Monashuni Melbourne

ULTY OF EDUCATION
Professor S. S. Dunn

24th October, 1972.

Dear

A short time ago I sent you a copy of a questionnaire concerning staff and students at university. To date, the response from students and staff have been exceptionally good, but I note that I have not yet received your reply.

You may have mislaid the questionnaire, or you may have uncertainties concerning its completion. If the latter is the case, I would like to reiterate a number of points concerning the questionnaire.

Every reply is important to the study. Your views will not be lost in a mass of averages or percentages - they are important in their own right, even if you have discontinued your studies.

Your replies shall be held in strict confidence. The list associating names and numbers will be destroyed shortly.

I appreciate that the questionnaire does come at a busy time for you, but I would urge you to put aside a little time to complete it, before Friday 27th October. If you have mislaid your copy of the questionnaire, could you contact me at 544-0811 ext. 2869 and one will be forwarded to you.

Thank you for your assistance.

Yours sincerely,

(R.A. Docking),
Research Scholar

GENERAL INFORMATION

Late last semester you completed a questionnaire for me about tertiary education and lecturers at universities. Your answers have been partially analysed and are most encouraging. I have now reached the final stage of my study and again I ask you to assist me with it by the completion of the questionnaire enclosed. The questionnaire has been mailed to you so that class time will not be taken up, and so you can complete the questionnaire at your leisure. I ask you to fill it in now, as the study requires that it be completed as close as practicable to the time of the examinations. To remind you of the purposes of the study, I reiterate some of the comments on the introductory page of the first questionnaire.

> This questionnaire is part of a study of staff and students at tertiary institutions. The study is being conducted with the approval of the Chairman of the Physics Department, and your lecturers. This research was initiated by the observation that students often feel misunderstood, or that their individual needs and interests are not recognised by their lecturers. The breakdown in communication between staff and students can often have detrimental effects on interest and performance in subjects, that may result in failure. This study, then, in seeking areas of communication breakdown, may have far reaching effects for students in the future, even for you in later years. For this reason I ask you to approach this questionnaire seriously, and answer as best you can.

The questionnaire consists of four parts. Part A does not require any responses from you. However, I would like to draw your attention to the identification number on the front. This arrangement enables me to add your answers from this questionnaire to the information from your first questionnaire. At the same time it guarantees anonymity should your reply go astray in the return post. Although these steps have been taken it is necessary for me to further assure you that no information will be released that will allow individual students to be identified. The information will be used in a statistical manner, and will not be made available to any staff in your Faculty, the University, or any other persons or organizations.

In Parts B and C you are asked to respond to a number of statements about a university education and lecturers, by selecting the appropriate response to each. In Part D you are asked to identify important sources of influence in the development of your ideas, by selecting influences from a given list.

Although there is no time limit on the questionnaire, the whole questionnaire should take you no more than fifteen minutes to complete, if you answer as quickly as you can.

Monash University
CLAYTON VICTORIA AUSTRALIA
TELEPHONE: 544 0811 TELEGRAMS: Monashuni Melbourne

ULTY OF EDUCATION
: Professor S. S. Dunn

23rd October, 1972.

Dear

A short time ago I sent you a copy of a questionnaire concerning staff and students at university. To date, the response from students and staff have been exceptionally good, but I note that I have not yet received your reply.

You may have mislaid the questionnaire, or you may have uncertainties concerning its completion. If the latter is the case, I would like to reiterate a number of points concerning the questionnaire.

Every reply is important to the study. Your views will not be lost in a mass of averages or percentages - they are important in their own right, even if you have discontinued your studies.

Your replies shall be held in strict confidence. The list associating names and numbers will be destroyed shortly.

I appreciate that the questionnaire does come at a busy time for you, but I would urge you to put aside a little time to complete it, before Friday 27th October. A second copy of the questionnaire and a post-paid envelope are enclosed for your reply.

Thank you for your assistance.

(R.A. Docking)
Research Scholar

GENERAL INFORMATION

Late last semester you completed a questionnaire for me about tertiary education and lecturers at universities. Your answers have been partially analysed and are most encouraging. I have now reached the final stage of my study and again I ask you to assist me with it by the complation of the questionnaire enclosed. The questionnaire has been mailed to you so that class time will not be taken up, and so you can complete the questionnaire at your leisure. I ask you to fill it in now, as the study requires that it be completed as close as practicable to the time of the examinations. To remind you of the purposes of the study, I reiterate some of the comments on the introductory page of the first questionnaire.

> This questionnaire is part of a study of staff and students at tertiary institutions. The study is being conducted with the approval of the Chairman of the Physics Department, and your lecturers. This research was initiated by the observation that students often feel misunderstood, or that their individual needs and interests are not recognised by their lecturers. The breakdown in communication between staff and students can often have detrimental effects on interest and performance in subjects, that may result in failure. This study, then, in seeking areas of communication breakdown, may have far reaching effects for students in the future, even for you in later years. For this reason I ask you to approach this questionnaire seriously, and answer as best you can.

The questionnaire consists of four parts. Part A does not require any responses from you. However, I would like to draw your attention to the identification number on the front. This arrangement enables me to add your answers from this questionnaire to the information from your first questionnaire. At the same time it guarantees anonymity should your reply go astray in the return post. Although these steps have been taken it is necessary for me to further assure you that no information will be released that will allow individual students to be identified. The information will be used in a statistical manner, and will not be made available to any staff in your Faculty, the University, or any other persons or organizations.

In Parts B and C you are asked to respond to a number of statements about a university education and lecturers, by selecting the appropriate response to each. In Part D you are asked to identify important sources of influence in the development of your ideas, by selecting influences from a given list.

Although there is no time limit on the questionnaire, the whole questionnaire should take you no more than fifteen minutes to complete, if you answer as quickly as you can.

APPENDIX II

SAMPLE EXAMINATION PAPER

Please Note: The complete set of examination papers has not been included, as:

1. Identifying remarks have been removed to prevent the possible identification of individual lecturers, as required by the obligation to preserve anonymity.

2. The total set of papers from which the data was obtained are very bulky, about 90 pages. As no reference could be made to htme, their inclusion could be superfluous.

ANNUAL EXAMINATIONS 1972

FACULTY OF SCIENCE

INSTRUCTIONS TO CANDIDATES: *DURATION:* 3 HOURS

PHYSICS 301 & 303

FIRST PAPER

SECTION A - SPECIAL RELATIVITY - $1\frac{1}{2}$ hours.

SECTION B - STATISTICAL MECHANICS - $1\frac{1}{2}$ hours.

(i) Answer all questions in Section A.

Answer any two (2) questions in Section B.

(ii) Answer different sections in separate book.

(iii) Total marks allocated for this paper is 180.

The allocation of marks for each question is given at the beginning of each question.

(iv) This paper has 3 numbered pages.

SECTION A

SPECIAL RELATIVITY

DURATION: $1\frac{1}{2}$ hours.

Answer All Questions in this section.

30 marks.

A.1. (a) Define the "interval" between two events.

(b) Given that the interval, suitably defined, between two events is invariant, show that the proper time interval is invariant and deduce the relation between proper time and ordinary time.

(c) Write the expression for the four-velocity and find its invariant magnitude.

(d) Deduce the relativistic velocity addition formula.

30 marks.

.2. A proton of rest-mass M and speed u collides with a proton at rest. The collision produces two protons and a meson of rest-mass m. Prove that for this to be possible

$$\gamma\,(u) \geq 1 + \frac{2m}{M} + \frac{m^2}{2M^2}.$$

where $\gamma\,(u) = \left(1 - \frac{u^2}{c^2}\right)^{-\frac{1}{2}}$

30 marks.

.3. Derive the relativistic expression for the Doppler effect for light signals. Comment on the differences between this and the corresponding classical expression.

SECTION B.

STATISTICAL MECHANICS.

DURATION: $1\frac{1}{2}$ hours.

Answer any TWO Questions in this section.

45 marks.

B.1. (a) Explain the physical basis of the argument which Gibbs used to introduce ensembles.

(b) Describe the phase space of

(i) a free particle in a "linear box"

(ii) a simple harmonic oscillator in three dimensions.

(iii) an ideal gas.

45 marks.

B.2. (a) Prove that the probability P_r of finding a system in a state with energy E_r, when it is in equilibrium with a heat reservoir is given by

$$P_r = C \exp\{-E_r/kT\}$$

where k is Boltzmann's constant and T is the absolute temperature and where C is a constant.

(b) Consider the atmosphere round the earth (of mass M and assumed to be sperical of radius R). If the temperature of the atmosphere can be taken to be a constant, show that the mean density of the atmosphere n(r) at a radius R ($>$ R) from the centre of the earth is given by

$$n(r) = n(R)\, e^{-G\frac{Mm}{kT}\left(\frac{1}{R}-\frac{1}{r}\right)}$$

where G is the gravitational constant and m is the mass of a molecule.

(c) Using this expression for n(r), show that the total amount of gas in the atmosphere would be infinite and interpret this result.

45 marks.

B.3. "In nature, there are three kinds of elements; fermions, bosons and localized particles". (C.A. Swenson)
Discuss this statement in terms of the symmetries of quantal wave functions and the three statistical mechanical distributions.

TURN OVER

45 marks.

B.4. A paramagnetic system containing N non-interacting atoms each with a magnetic moment μ is placed in an external magnetic field of induction B. The magnetic moments can be either parallel or antiparallel to the magnetic field.

(a) Prove that the mean energy $\bar{E}$ of the system is given by

$$\bar{E} = -\mu BN \tanh \beta\mu B$$

where $\beta = 1/kT$.

(b) Prove that the mean magnetic moment of the system is given by

$$M = M_o \tanh \beta\mu B$$

where $M_o = \mu N$

(c) Given that the mean fluctuation is defined by

$$\overline{(E - \bar{E})^2} = -\partial\bar{E}/\partial\beta$$

prove that for this paramagnetic system,

$$\overline{(E - \bar{E})^2} = kTXB^2$$

where χ is the magnetic susceptibility of the system.

45 marks.

B.5. (a) Explain the significance of the partition function Z in a statistical mechanical argument.

(b) Prove that the mean energy $\bar{E}$ is given by

$$\bar{E} = -\partial(\ln Z)/\partial\beta.$$

(c) A thermodynamic system has the number of energy states $\Omega(E)dE$ in the energy range E to E + dE given by

$$\Omega(E)dE = AE^f dE$$

where E is a continuous variable and f is a large number: $f \gg 1$.
Prove, using the result of (b) above that $\bar{E} = fkT$.
Comment on whether you would expect this.

Use the integral $\int_0^\infty x^n e^{-ax} dx = n!/a^{n+1}$.

45 marks.

B.6. An anharmonic atomic oscillator in a solid is represented by the potential

$$V = cx^2 - fx^4.$$

where f is small. Show that the specific heat of a system of 3N such localized independent anharmonic oscillators is

$$C = 3Nk\,[1 + 3fkT/2c^2].$$

Comment on the behaviour of specific heats of solids at high temperatures. Use $\exp\{f x^4/kT\} \approx 1 + f x^4/kT$,

and $$I = \int_{-\infty}^{+\infty} e^{-tu^2} du = (\pi/t)^{\frac{1}{2}},$$

and $$\frac{\partial^2 I}{\partial t^2} = \int_{-\infty}^{+\infty} u^4 e^{-tu^2} du = \frac{3}{4} (\pi/t^5)^{\frac{1}{2}}.$$

APPENDIX III

PUBLICATIONS AND PAPERS

Page

III - I 'Intellectual styles in Higher Education - Paper presented at the 1972 A.P.S. Conference, Canberra. ... 303

III - 2 'A prediction model of student achievement in the first year of Diploma of Teaching (Primary), The Australian Journal of Higher Education, 4, pp.217-224, 1972. ... 319

III - 3 'Perceived influences on tertiary students' academic attitudes - a comparative study'. V.I.E.R. Bulletin, 30, pp.35-47, 1973. ... 327

III - 4 'Intellectual environment and academic achievement at tertiary level'. Paper presented at the 1975 A.A.R.E. Conference, Adelaide. ... 341

INTELLECTUAL STYLES IN HIGHER EDUCATION

Paper presented at the 1972 A.P.S. Conference

Canberra, A.C.T.

Wednesday, August 23.

Symposium: Motivation in Higher Education

Russell A. Docking, B.Sc., B.Ed.
Research Scholar
Monash University

A consideration of interests, motives, attitudes and intellectual styles in late secondary or tertiary education with particular attention to intrinsic motivation.

At present I am engaged in a research project for a higher degree, which involves intellectual styles and role orientations in tertiary education. I propose to present to you an outline of this research in this paper, with particular emphasis on intellectual styles.

My research broadly seeks to determine if incompatibility in the intellectual styles of staff and students affects student achievement. It is based on a number of assumptions that have support in research elsewhere.

. The first is that an individual's view of all external stimuli is modified by a perceptual filter or frame of reference within the observer. This is the basic tenet of phenomenology, pioneered by Murray (1938).

. The second is that this perceptual filter is directly related to the goals or motives of the individual, and that these goals or motives are in turn directly related to the individual's personality. Marks (1968) demonstrated this in a study of personality and environmental perception, as measured by the College Characteristics Index.

. The third assumption is that one behaves consistantly with ones own interpretation of external stimuli, both environmental and interpersonal (Festinger, 1962). This is simply a statement that one acts rationally according to one's own perceptions. This assumption also refers to that class of behaviours that reveal intellectual styles. It follows that any interaction effects predicted by frame of reference models would be observable through intellectual styles. The word behaviour in these assumptions describes all the activity of an individual, whether the activity has an immediate effect or a delayed effect. Similarly, interaction need not necessarily be the result of immediate stimulus, as in conversation, but may be time-delayed, as in correspondence.

In a person to person interaction, one participant's behaviour is the other person's stimulus, and vice-versa. It is likely that the evaluation of an individuals behaviour by an observer would be influenced by the observer's perceptual filter or frame of reference, and that this evaluation would be more favourable if the behaviour was more compatible with the frame of reference. If these assumptions are accepted, three hypotheses can be framed relating to student learning and assessment, as follows:

1. A student shall learn more readily from a lecturer whose intellectual style is most comptaible with his own. The word learning may lead to some confusion in this hypothesis. I do not mean the accumulation of facts but rather the acquisition of cognitive skills. The lecturer is not seen as a source of information, but rather as a facilitator of learning.

2. A student shall interpret more accurately the requirements of an examiner whose intellectual style is most compatible with his own.

3. An examiner shall assess more favourably the performance of a student whose intellectual style is most compatible with his own.

These hypotheses have been hinted at by other writers, notably Ausuble and Robinson (1969), Baird (1971), and Jones and Thibaut (1965), and similar hypotheses have been researched by McKeachie (1961) and by Runkel (1956), but the evidence from these studies is not clear. McKeachie showed definite effects on learning related to the interaction of teaching methods and student motives. However Runkel showed that similarity in cognitive preferences in psychology had no significant relation to achievement in psychology. The question still remains as to whether compatibility of intellectual styles in general has an effect on learning and achievement.

Certain experimental conditions must be met before any of these hypotheses can be tested. Firstly, there must be a substantial number of students taking a mutual or common set of at least three subjects. Secondly, the lecturer in each subject must also be it's examiner. Thirdly, measurement of students and lecturers would have to take place just before the examinations. Finally, and this is a requirement that owuld only fail to be met in rare circumstances, at least three of the lecturers would need to have unique intellectual styles. The need for these conditions will become more evident as the whole study is described.

In order that the study is conducted within a sound theoretical framework, with valid, reliable and measurable variables, the problem being researched must be considered in more detail. To reiterate, the study seeks to determine if an interaction between staff and student intellectual styles at tertiary level affects student achievement. A number of points arise from this. A model of classroom interaction applicable to tertiary education is required, a logical and meaningful set of intellectual styles must be operationally defined, a meaningful measurer of achievement must be derived , and statistical procedures for identifying intellectual styles, determining compatibility of styles, and testing effects of interaction must be brought together.

A number of models or paradigms of staff-student interaction have been proposed. In my view, the most useful of these is attributed to Runkel and reported by Gage (1965). It is, in fact, largely based on the same assumptions that I have already outlined. I will not attempt to describe the paradigm to you in full, but I will consider a number of it's weaknesses and how these can be overcome.

In it's complete form Runkel's paradigm has a cyclic nature, (see Fig. 1), representing a dynamic, on-going interaction. Feedback loops illustrate the continuous monitoring by one participant of the other participant's responses. This dynamic and spasmodic nature of the general interaction situation makes it extremely difficult to isolate effects. The lecture situation to some extent reduces the interaction to a linear rather than circular form. Usually there is very little opportunity for the student to indicate perceptual confusion, or for the lecturer to get immediate feedback from the students. There are, however, non-verbal cues that the lecturer may perceive, and these must not be ignored. Fortunately the other venue of obligatory staff-student interaction, the examination, is sufficiently controlled to enable one to employ Runkel's model gainfully.

In the examination situation, there is a time-lapse between the teacher's act (setting the examination), the student's response (writing the answers),and the teacher's reaction (marking the answers), preventing oscillatory feedback during each participant's performance. Thus the paradigm takes a simple linear form, and can be easily applied to the situation.

There are two further criticism of this and other paradigms cited by Gage. Firstly, in the typical classroom, the teacher deals with more than one pupil at a time, and secondly, there is also student-student interaction. Neither of these situations is accounted for by the models. These are perfectly valid criticisms, but it can readily be seen that they apply only partially to the lecture situation, and not at all to the examination situation.

In summary, Runkel's model provides a useful structure for the understanding of intellectual style interaction, when used under controlled conditions, such as examinations. As the lecture situation is too complex to interpret, only the second and third hypotheses can be tested. In fact, only the third will be tested, that is: that an examiner shall assess more favourably the performance of a student whose intellectual style is most compatible with his own.

Intellectual styles need to be clearly and operationally defined. The danger inherent here is that the styles could be defined so narrowly that they sample only a small, and perhaps insignificant, part of intellectual behaviour. In this study, intellectual styles are defined in terms of three factors which relate directly to education. The three are: the amount of intellectual activity, the diversity of intellectual activity, and the acceptance of externally set intellectual standards and goals. Eight intellectual styles can defined by dichotomising these factors (See Fig. 2). They have been given names, such as vocationalist, scholar and dilettante, but there is a danger that these may take on unintentional connotations. For example, the cell marked with an asterisk has been called intelligensia, as it's factor scores seem to describe what the Oxford Dictionary calls that group 'that aspires to independent thinking'. But the name intelligensia carries with it other meanings, particularly from its application to radicals in communist countries, that may be misleading. The names used are only labels and their limited definition must always be kept in mind.

The three factors which define the intellectual styles are measured by a thirty item questionnaire, with ten items making up each factor. This is administered to students who report their own perceptions, and to staff who are asked to indicate their idea of the perceptions of the ideal student. Each item must have a moderate correlation with its factor (not too high, because then the item would be redundant) and have a very low correlation with other factors. Scales made up of items with these characteristics are called factor pure scales (Cattell and Warburton, 1967), providing the greatest scope for maximum validity. Some items have been selected from research conducted by Katz and others (1969) in Sydney, and from reports of studies collected by Feldman and Newcomb (1969). The balance of the items were designed to complete the factor's description.

The remaining aspect of the study to be considered, that of statistical procedures, will only be dealt with briefly here. They must be described, however, since they complete the definitions of some variables, such as achievement, and tie the other parts of the study together. The analysis will consist of a number of stages.

The first stage involved the application of a set of reliability measures, determining test-retest reliability, cross-situational reliability, and internal consistency. A quite unusual technique shall be employed to determine the reliability indices. They shall be measured in terms of intellectual style stability. The probability of any observed changes in type after retesting can be calculated and significance levels determined.

The second stage will involve the application of cluster analysis techniques, using stereotypes as identifiers, to the factor scores of the respondents. Cluster analysis compares profile scores, forming groups of maximum similarity, that is maximum intragroup homogeneity and maximum intergroup separation. The technique developed by Cattell and Coulter has been chosen for this study, because it does not have any of the limitations that plague other taxonomic methods. (Cattell and Coulter, 1966). It does not depend on orthogonality of factors, and accounts for all the properties of profiles simultaneously. (Shape, accent, and displacement). It does not produce hierarchial grouping, which really only applies to biology, but delineates phenomenal clusters. This shall be followed by multiple discriminant analysis to refine grouping. The technique identifies the variables which make no contribution to the separation of the groups. These can then be dropped from future analysis. The whole of stage two will be repeated until maximum group discrimination is obtained.

Compatibility of groups can then be determined in terms of group to group centroid distances.

The final stage requires each student's standardised scores in the four or five subjects taken in the first semester to be ranked. By ranking a student against himself, such background variables as intelligence, personality, study habits and so on can be controlled. These ranks, which are the final measures of achievement, can then be compared to hypothesised rankings derived from a consideration of the compatibility of the student with each staff member. This can be illustrated by a diagram. (See Fig. 3) In this example, student type 1 is most like lecturer type A and least like B. Student type 2 is most like B and least like E. Page's L-test (1963) can be used to test if the ranks observed are significantly different from the ranks hypothesised. Non-parametric analysis of variance can be used to determine the contributions of the main effects and to detect any unpredicted interactions. (Bradley, 1968).

This completes the outline of the study, with a few omissions. These relate to areas of research outside the area of this particular symposium, but for the same of completeness I shall mention them. I am not only interested in the effects of compatibility of intellectual styles on achievement, but also in the effects of compatibility of perceived and ideal lecturer role on achievement. To measure this, a further thirty items are incorporated in the questionnaire. Finally, cross factor studies will be conducted to determine the relationships between intellectual styles and perceived lecturer role.

This research was started in 1971. To date, a pilot study has been completed, mainly to assist in the development of the questionnaire. The administration of the revised questionnaires to all the staff and students in the Physics Department at Monash university has just been completed. The administration took place during the week immediately prior to the first semester examinations. Returns amounted to ninety-five percent of the total administered, and over seventy-five percent of those readministered for reliability estimates. Analysis is expected to take a further two months to complete.

This, then, is an example of current research on the intellectual styles of students at tertiary level. It is in no way intended to indicate the only line that research can take in this area, but it illustrates some of the problems that arise and the techniques that may be used to overcome them. I appreciate that I am only studying a fragment of the field, but I believe that the outcomes of the study will be of interest to educationalists and psychologists alike.

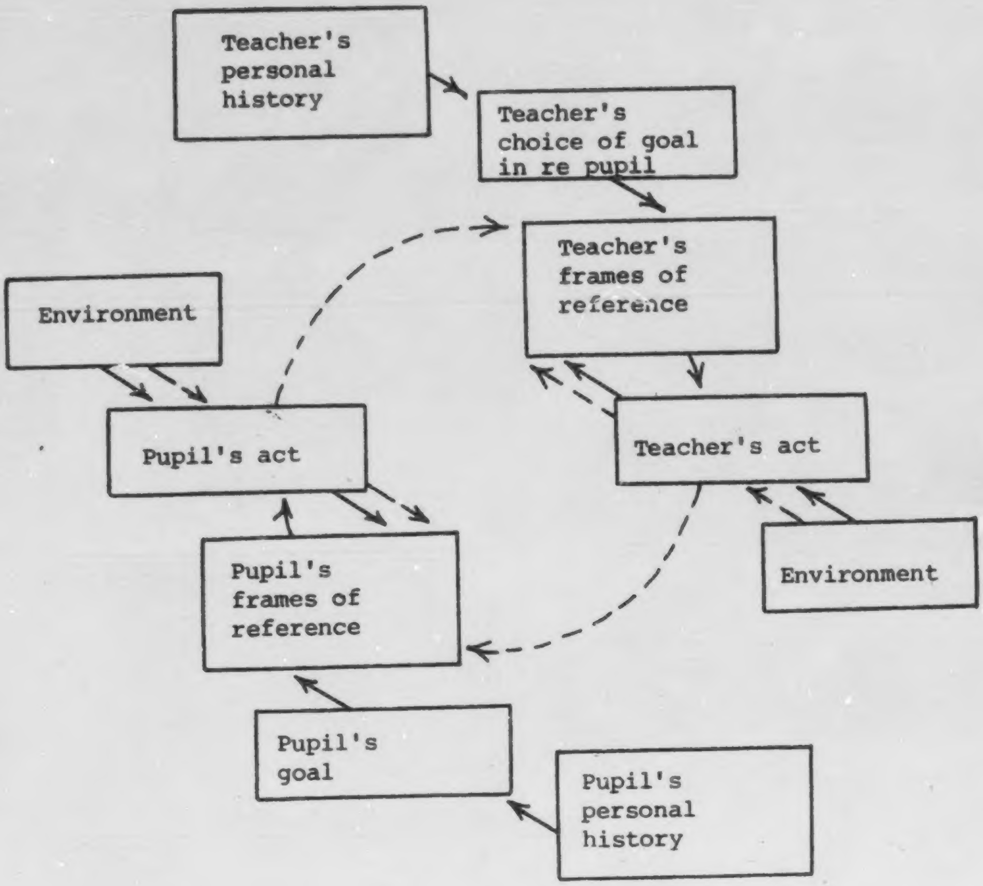
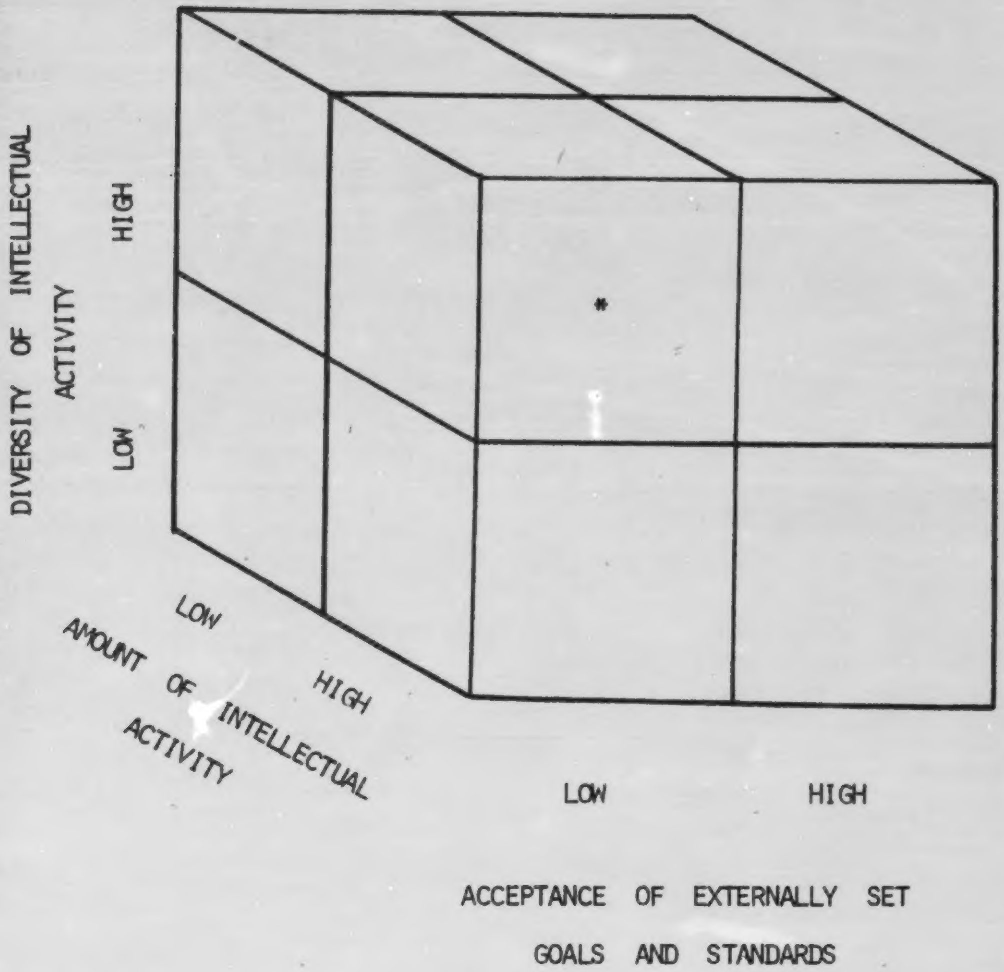

Teacher's personal history
Teacher's choice of goal in re pupil
Teacher's frames of reference
Environment
Pupil's act
Teacher's act
Environment
Pupil's frames of reference
Pupil's goal
Pupil's personal history

FIGURE 3

	TEACHER TYPE				
STUDENT TYPE 1	A	B	C	D	E
HYPOTHESISED RANK	1	2	3	4	5
OBSERVED RANKS	1	3	2	4	5
	2	1	3	5	4
	1	2	3	4	5
	1	3	2	4	5
	.	.	.	.	.
	.	.	.	.	.

STUDENT TYPE 2					
HYPOTHESISED RANK	4	1	2	3	5
OBSERVED RANKS	5	2	1	3	4
	4	1	3	2	5
	4	2	1	3	5
	4	2	3	1	5
	.	.	.	.	.
	.	.	.	.	.
	.	.	.	.	.

FIGURE 2


DIVERSITY OF INTELLECTUAL ACTIVITY
HIGH
LOW
*
LOW
HIGH
AMOUNT OF INTELLECTUAL ACTIVITY
LOW
HIGH
ACCEPTANCE OF EXTERNALLY SET GOALS AND STANDARDS

INTELLECTUAL STYLES

FIGURE 3

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A PREDICTION MODEL OF STUDENT ACHIEVEMENT IN THE FIRST YEAR OF DIPLOMA OF TEACHING (PRIMARY)

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Prediction of achievement from earlier performance and other variables is a perennial problem of administrators and teachers at all levels of education. It is generally assumed that performance in previous studies is a sufficient predictor of future achievement, and this has led to selection or promotion procedures based purely on the result of a test or battery of tests. The fact that tests do not, in general, provide consistent prediction simply because they have the same title as the criterion test, or because they immediately precede the course they are said to predict, has led to studies of other variables that may improve prediction (for example, Entwistle, 1968; Jones and Grieneeks, 1970 and Lewis, 1970), or the design of tests specifically to predict within limited areas. Such tests are said to have criterion (or predictive) validity. They are usually formed by the construction of tests that have content validity, followed by the elimination of items that do not independently correlate highly with the criterion variable. This process eventually produces a test that, as long as the criterion does not change in form, will quite effectively predict performance of that criterion. The final trial is conducted on a completely different sample of subjects (students) from those used in the development of the test, this final check being known as "cross-validation". Tests of this kind have been constructed for a variety of purposes, but due to the changing nature of courses-and because of the large range of courses available, they are not in wide use.

Selection or promotion decisions are therefore usually based on quite a different kind of test, the achievement test. The achievement test at the transition between secondary and tertiary level education in Victoria is the Higher School Certificate (H.S.C.) examination. The same test is used by a wide variety of institutions to select applicants for places. Often selection is based on a composite score (for example, the total of the marks obtained in the best three subjects, called the Anderson score) and this further confounds matters as the contribution of individual subjects as predictors is lost. Thus, a student scoring well in humanities subjects but poorly in science subjects would have a good Anderson score that may enable him to gain admission to a science faculty. Furthermore, if performance in a number of subjects is highly correlated, students taking those courses will tend to the extremes (very high or very low) when the scores are added, giving an exaggerated predicting score. For this reason students taking pure science courses or language courses in H.S.C. tend to dominate the top places based on the Anderson score. Equal scores in H.S.C. may not be of equal merit, as they may have been attained under different conditions, such as ill-health or cultural deprivation. These and other factors throw much doubt on the validity of the use of the H.S.C. examination as a predictor, and stimulate a search for other information that, combined with the H.S.C. in some way, might improve prediction.

The selection and prediction problems of a teachers' college are quite unique, in that the students undertake a very wide course, covering subjects ranging from physics to physical education, and so no specific combination of H.S.C. subjects is superior in preparation to any other. For this reason it is appropriate to use the composite score (Anderson score) as a measure of H.S.C. performance. This study seeks to determine the extent to which H.S.C. is a predictor of first year performance in a diploma of teaching (primary) course, and to determine what other factors, linearly combined with H.S.C., can improve the prediction significantly. First year performance is measured by the sum of the standardised scores of five subjects undertaken by each student. This is a rather rough criterion measure, but it is related to the predicting Anderson score which is also calculated across different subjects.

STATISTICAL TECHNIQUES

Multiple regression analysis was used to derive a linear equation of the form:

$$\hat{Y} = B_1X_1 + B_2X_2 + B_3X_3 + \ldots\ldots + B_nX_n + R$$

where $\hat{Y}$ is the estimate of achievement determined from the equation, B_1 are the weightings that maximise prediction using the scores on factors X_1, and R is the regression constant.

The weightings for each factor were determined using a programme from Veldman (1967), adapted so that correlations can be determined even if data are missing on some variables for some subjects. F-tests were conducted to compare the predicting power of different sets of factors.

Caution must be taken in the interpretation of the results, as the weightings (B_1) are based on correlation coefficients which may themselves be in error or not significantly different from zero. The use of the F-test enables one to test the effect of reducing the number of variables (X_1), starting from the least important, until further reduction results in significantly weaker prediction, and so overcomes this difficulty. A second problem lies in the homogeniety of the sample. The use of multiple regression analysis assumes a normal distribution of responses, not only on individual scales but also in the multi-dimensional space formed by all the scales taken together. Previous research with this sample has demonstrated that there are actually six distinguishable groups[1] and that these groups differ in their performance characteristics, so that it would be wiser to treat these separately and derive six different regression equations. This presents two problems. The first is that the subgroup sizes are too small (the largest group has 45 members) and so signicicant correlations would be hard to obtain. The second involves the process of selection, as all applicants would have to complete the questionnaire in order to be typed, and then their particular regression equation applied. This process is far too complex, and so a single regression equation must be determined. If it can be shown that the extra information improves prediction despite the drawbacks already mentioned, then it will be of some use in selection.

RESULTS

A total of 160 students were administered the Student-goal Orientation Questionnaire[2] at a voluntary meeting during class hours. This represents 50 percent of the total first year diploma (primary) class. No sampling biases were detected; all course combinations allowed were represented in the sample.

TABLE 1

COMPARISON OF SAMPLE AND POPULATION MEANS ON OBJECTIVE TYPE VARIABLES

Variable	*Sample*	*Population*
Sex (percentage male)	18	17
Socio-economic status [a]	4.8	n.a. [d]
Age (years)	18.6	n.a. [d]
Anderson score [b]	187	187 (Median)
First year achievement [c]	256	250
Number	160	317

a. as measured by occupation of the head of the household rated on Congalton's seven point scale.
b. sum of the best three Higher School Certficate marks.
c. sum of the standardised scores on the five subjects undertaken by each student.
d. not available.

The sample consisted of 27 men and 133 women, reflecting the imbalance of the sexes existing at the college. Age ranged from 17 to 22 years. Only one student was not supported by a studentship. Socio-economic status (S.E.S.) as measured by the occupation of the head of the household scaled on Congalton's (1969) seven point scale, ranged from 1.87 to 7.46, with a mean value of 4.76. (In effect this covers the complete range of occupations, the mean occupation being the equivalent of a plumber, land agent, tenant farmer or industrial foreman.) As primary teachers are rated in the same scale at 4.30 (high status occupations score low on this scale), for most students the training represents an upward mobility step. There is no significant difference between the sexes in S.E.S. Sixty-six percent of the students in the sample were living at home with their parents, 21 percent at the college hostel, 9 percent in a shared flat or house, 3 percent were boarding with friends or relatives, and 1 percent had their own flat or house.

As mentioned earlier, this sample had been the subjects of research which involved the administration of a questionnaire that measured motivation and attitude variables. This study uses two sources of information in deriving two regression equations. The first uses all available data, the second only data readily obtained from application forms.

TABLE 2
PREDICTORS OF ACHIEVEMENT, THEIR WEIGHTINGS, AND THE REGRESSION CONSTANT

Predictor X	*Weighting*	
H.S.C. Anderson score	.69	
Clarity of objectives	8.94	from an item
Residence[1]	-4.56	see footnote
Perceived quality of teaching	-10.88	from an item
Anti-intellectual scale score	-2.31	from a scale
Motivation to meet externally set standards and goals	.65	from a scale
Socio-economic status	-2.33	Congalton's 7-point scale
Regression constant	176.69	

[1] Rated:
1—Home with parents
2—College hostel
3—Boarding with friends or relatives
4—Shared flat or house
5—Own flat or house

Table 2 lists the most important variables, their weightings, and the regression constant found when all available data are used. It can be seen from figure 1 that taking these variables together only accounts for 33 percent of the variance, although if a complete regression equation is formed, using all 32 variables, 38 percent of the variance can be accounted for. This is equivalent to a correlation of .62 between actual and predicted scores, which is considerably greater than the correlation of .42 that is obtained if H.S.C. only is used. ($p < 0.002$) Thus it can be seen that the addition of factors to H.S.C. does improve prediction. The problem of obtaining this information remains formidable and so it is of little practical use. The list in table 2 does throw some light on the sorts of factors that are important in achievement at first year level, and warrants discussion.

It is not unexpected to find a measure of academic ability, the H.S.C. examination, being the major predictor of further academic success. It is important to note, however, that while it is the most important, it still only accounts for only 17 percent of the variance in first year achievement.

The students' response to the item: "I have a clear educational goal in mind that I am determined to attain" constitutes the second most important predictor. This would be related to motivation or ambition which are factors that have been reported as important in other studies. (cf. Entwistle et al., 1971; Lavin, 1965:76)

Residence, as a predictor, presents some difficulty in interpretation. The answers were scaled according to a subjective evaluation of independence, from "home with parents" (low independence) to "own flat or house" (independent). The importance of this as a predictor to some extent validates this scaling.

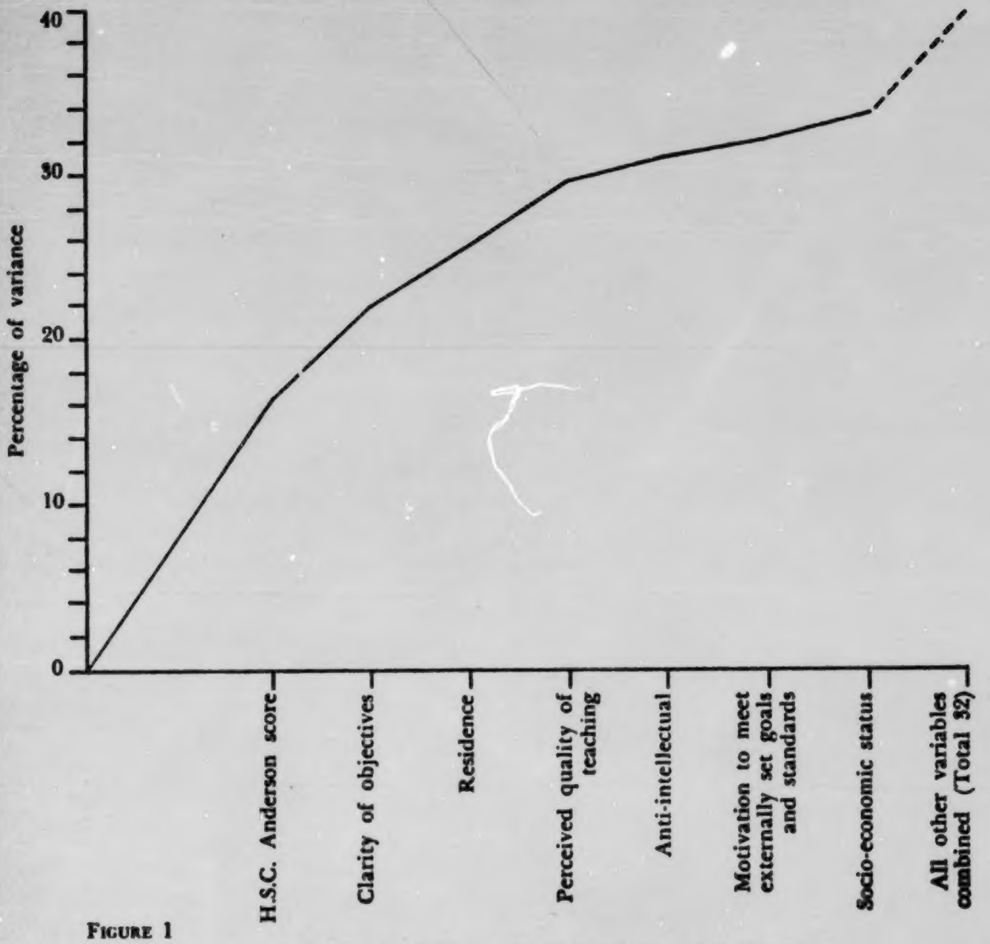

Figure 1
PERCENTAGE OF VARIANCE IN ACHIEVEMENT PREDICTED

The students' answer to the item: "I have a great deal of respect for this place as a teaching institution." is the next most important predictor. It is negatively correlated with the criterion variable and has a negative weighting, suggesting that those with little respect will perform better than those who express high regard for the institution. This unusual result is in accordance with the results of the previous study[8] which showed that a rebel group (the "intellectual" group) performed better in their first year studies. (See also Gottlieb and Hodgkins, 1963:279. They use the term "non-conformist" instead of "intellectual".)

The remaining three factors listed in Table 2 (Anti-intellectual, motivation to meet externally set standards and goals, and socio-economic status) are weighted in the directions expected. The first two support the scale definitions used in the construction of the questionnaire from which they are derived. (The anti-intellectual or "misfit" scale consists of five items; the other scale of ten items.)

It is important to note that Congalton's scale is an inverse scale. Thus students with a high S.E.S. background will tend to perform better than students of a low S.E.S. background. It is worth recalling that achievement is being assessed from the sum of five subjects, so that while the weighting of −2.33 on S.E.S. can introduce a variation of about 14 points, which is statistically significant, this means a variation of about three points per subject, which would be of little consequence in practice.

There is a number of other factors that carry significant weights. These are listed below:

"The best way to find out what we are here to learn is to look at past examination papers." (B = −3.36) Those who disagree do better.

"We are not given any ideas about the objectives of the courses here." (B = 4.88) Those who agree perform better.

"The staff seem to hold different views of the purpose of our education here." (B = −3.22) Those who disagree perform better.

These three are concerned with the clarity of objectives. Rather than trying to change things it seems to be better to accept things as they are:

"Students should have a say in the planning of courses." (B = −6.53)

"There is too much work expected of us here." (B = −3.32)

The regression equation derived from the so called "objective" variables (sex, age, etc.) presents a much simpler picture. Table 3 lists the five variables used, and their weightings.

TABLE 3

PREDICTORS OF ACHIEVEMENT, THEIR WEIGHTINGS, AND THE REGRESSION CONSTANT FOR "OBJECTIVE" VARIABLES

Variable X	*Weighting*	
H.S.C. Anderson score	.73	
Residence	−8.11	see footnote, table 2
Sex	10.53	(Male—1, Female—2)
Age (years)	3.73	
Socio-economic status	−1.68	
Regression constant	53.37	

All make significant contributions to the prediction of first year achievement. They account for a total of 23 percent of the variance in the first year performance (corresponding to a correlation of .48 between predicted and actual scores), the bulk of which is made up of the H.S.C. Anderson score (17 percent). The correlation of .48 is not significantly greater than the correlation obtained if H.S.C. is used alone (.42). Figure 2 shows how the addition of factors increases the percentage of variance accounted for.

Calculation of the F-ratio shows that the increase in variance accounted for by the additional information is just significant (F = 2.274, d.f. (num) = 5, d.f. (den) = 154, $p < 0.05$).

Once again H.S.C., a measure of general ability (as it is the Anderson score), is the major predictor, followed by residence, sex, age, and S.E.S. Residence per se does not affect performance but some aspect involved with residence, such as independence, does.

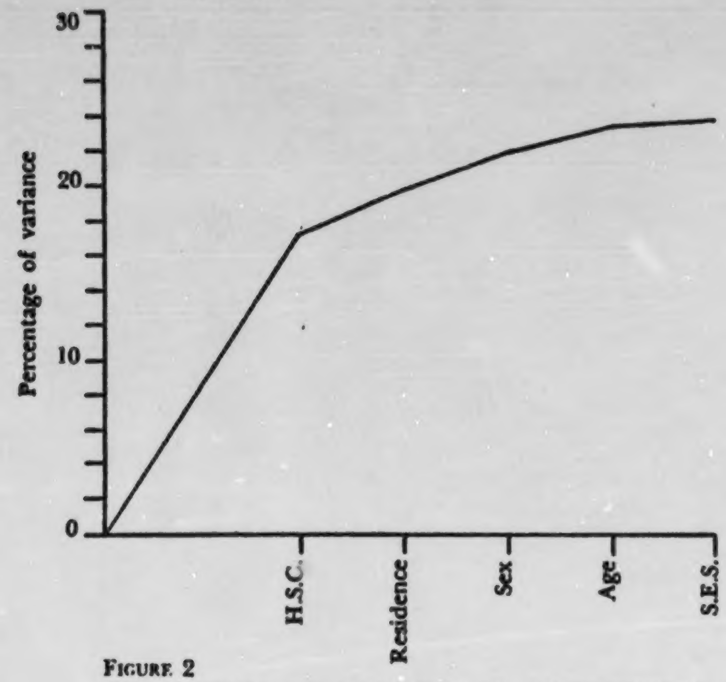

FIGURE 2

PERCENTAGE OF VARIANCE IN ACHIEVEMENT PREDICTED: OBJECTIVE VARIABLES

CONCLUSIONS

Prediction of first year performance in a Diploma of Teaching (Primary) course can be improved slightly by the use of additional information. The improvement is very great if information from the Student-goal Orientation Questionnaire is included, but this presents administrative problems and therefore is unlikely to be used for this purpose. The strongest effects that this questionnaire indicated involve clarity and acceptance of personal and institutional objectives.

A regression equation can be derived from "objective" type variables, as shown below:

Performance in first year
Diploma of Teaching (Primary) = .73 x H.S.C. Anderson score –
(Estimate) 8.11 x Residence rating +
10.53 x Sex rating +
3.73 x Age –
1.68 x S.E.S. rating +
53.37.

S.E.S. appears to be of little importance in this and the previous regression equation. This may be because it could have already played a part in the determination of H.S.C. performance. (The correlation between H.S.C. and S.E.S. is only -.19, $p < 0.05$.) This lack of importance has been noted elsewhere (for example, Entwistle, 1968; Lavin, 1965:128).

It has been found that Higher School Certificate performance is the best, but still a poor, predictor of academic success. Prediction can be improved by the use of other non-intellectual variables, but only to a marginal extent.

It would be useful for administrators involved in selection to keep in mind these factors, as awareness of their effects could help in difficult decisions. Further validation is required before the continuing importance of the objective variables can be assessed.

NOTES

1, 2, 3. See Docking (1972) "The Staff-role and Student-goal Orientation Questionnaires" Unpublished paper, Faculty of Education, Monash University. The questionnaires are introduced, and their use demonstrated with the staff and students at a primary teachers' college as respondents.

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PERCEIVED INFLUENCES ON TERTIARY STUDENTS' ACADEMIC ATTITUDES — A COMPARATIVE STUDY*

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A comparison of perceived sources of influence on academic attitudes is made between four groups of students, the first being from a Teachers' College (Primary) and the other three from the first, second, and third years of a physics course at university. Specific differences between college and university students and between students from different years of university, are hypothesised on the basis of observable environmental differences. These hypotheses are found to be supported by the results. The position of the lecturer as an influence in particular is studied, and found to be of greatest importance to the first year primary teachers-in-training and to the physics students in the second and third years.

The study of impacts on students has drawn the attention of many researchers in the area of education, particularly in relation to environmental and interpersonal interactions, and their effects on achievement, peer group formation and membership, socialisation, choice of occupation, attitudes, and attitude change. The author is at present engaged in a major study of this kind to gauge the effects of interpersonal interaction in lecture and examination situations on student achievement. Prior to conducting such a study, some determination of the perceived influence of lecturers on students is necessary to support certain assumptions about the interaction situation. Feldman & Newcomb (1969) provide a comprehensive review of research in this area, citing in detail twenty studies that deal with perceived influences on a range of students and in a variety of situations and locations. In general, the studies find that the lecturer or Faculty is the most important source of influence, but it is difficult to generalise from these studies to Australian universities.

In order to explore the situation in local tertiary institutions, a questionnaire was administered to two distinct groups of students, one consisting of first year students undertaking a Diploma of Teaching (Primary) at a metropolitan teachers' college, the other of first, second and third year students taking physics at a university.

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*This paper is based on the report which was awarded the 1972 G. S. Browne Prize for Educational Research.

Hypotheses

A consideration of environmental and course differences enables one to frame hypotheses relating to differences in sources of influence on college and university students, and on students in different years. In particular, conditions affecting the influence of lecturers on students include the size of classes, the appropriateness of the lecturer as a 'model'[1], the strength of opposition or dissident groups and the area of influence (e.g. academic, social, political).

The first hypothesis relates to differences in perceived influence in the academic area on students at teachers' college and at university.

Lecturers would be expected to have more influence on students at a teachers' college because of the smaller classes (although this may only be important if one class is *very* small), the relative lack of dissident groups (Freedman, 1956), and because the lecturers would be seen as exemplars of the teaching profession (particularly as they are usually the most successful teachers). In contrast, physics students are more likely to feel influenced to the greatest extent by their school teachers, as their studies are more of a continuation of school studies and are less vocational in nature, and because the students would have less opportunity for contact with their lecturers than their teachers' college counterparts[2]. Thus the first hypothesis is:

H1 *First year students at teachers' college would consider their lecturers as the most important influence on their attiudes to study, while first year physics students would consider their school teacher as the most important influence.*

The second hypothesis relates to changes in perceived influences as the students progress through their courses. In each successive year, the classes become smaller, allowing greater staff-student contact, the number of dissident students decreases (by maturation, socialisation or 'selection'), and the student becomes more aware of the lecturer as an appropriate model. On this basis, one would expect that the lecturer would become a more important source of influence.

H2 *University students would report lecturers as progressively more important influences as they move from year to year. Changes would be expected to occur during this transition period and not during the year.*

The latter part of this hypothesis is derived from the observation that the changes in conditions affecting influence (such as class size), occur between years and not within years.

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[1] *"This may mean merely that he is a model of adult behaviour or it may mean that he provides an ego-ideal to students, a source of inspiration worthy of emulation."* **(Feldman & Newcomb, 1969.)**

[2] *This is partly due to a conflict in roles for Faculty members at University, between teacher and researcher, and partly due to larger numbers of students.*

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[2] *This is partly due to a conflict in roles for Faculty members at University, between teacher and researcher, and partly due to larger numbers of students.*

The determination of perceived influences

To measure the student's perception of sources of influence, a questionnaire was administered as the last part of the attitude questionnaire used in the major interaction study. The whole questionnaire consisted of four parts. Part A sought background information from the students, Part B was the Student Goal Orientation Questionnaire (Student's intellectual styles), Part C the Staff Role Orientation Questionnaire, and Part D the Perceived Influences Questionnaire. Parts A, B and C were also administered to staff members, in a modified form, for congruence measures. A description of the development of these questionnaires can be found in Docking (1972c). Part D of the questionnaire took the following form:

> Throughout this questionnaire you have expressed your views about many different aspects of tertiary education and this university.[3] No doubt you formed most of these impresisons on your own, but other people will have influenced you.
>
> Below is a list of fifteen different types of persons or groups who may have influenced you in the development of your opinions.
>
> Before continuing, read through the list carefully.

Code number	Person or group
1	Parents.
2	Your lecturers as a group.
3	Organisations outside the university. (Church, social or sporting.)
4	Later year students, in the same course.
5	A school or university counsellor.
6	Non-tertiary peers (the wider group of your friends not at a tertiary institution).
7	A particular lecturer.
8	Demonstrators or tutors.
9	School teacher(s).
10	Relatives (Not immediate family).
11	One of your closest three friends.
12	Brothers and/or sisters.
13	University publications. (Student paper, etc.)
14	Tertiary peers (the wider group of your friends attending a tertiary institution, not including group 4).
15	University clubs or societies. (Sporting, cultural, etc.)

> In the following questions, you were asked to choose, in order, the two most important persons or groups who have influenced you in the formation of your opinions (APART FROM YOURSELF).
>
> Who have been the two most important influences:
>
> 1. in the development of your attitudes to this university (1) 1st 2nd

---

[3] *"University" was replaced by "College" in the teachers' college questionnaire.*

2. in the development of your attitudes to your studies in general	(2)	1st	2nd
3. in the development of your attitudes to Physics studies in particular[4]	(3)	1st	2nd
4. on your choice of course for this year	(4)	1st	2nd
5. on your choice of course for next year	(5)	1st	2nd
6. in the development of your attitudes to your lecturers as a group[5]	(6)	1st	2nd
7. in the development of your attitudes to politics[6]	(7)	1st	2nd

In answering part D some students felt they could not name influences beyond themselves and left items blank or answered 'me'. All such responses were classified as non-responses in the context of this questionnaire, which is mainly concerned with 'significant others'.

Research questions and techniques

The hypotheses can be put into general form as follows:

Q1 What differences are there in perceived sources of influence between first year teachers' college students and first year physics students?

Q2 What differences are there in perceived sources of influence between physics students in different years of their courses?

Prior to researching these questions, some determination of the reliability of the questionnaire must be made. Questions relating to this are:

R1 Do the choices always follow some pattern related to the order given in the list of alternative influences? (The so-called donkey vote, for example.)

R2 Are the students consistent in their responses over a period of one week?

R3 Are the students consistent during the year (as proposed in R2), and in their retrospective perception of influences in the previous year?

The questionnaire was administered four times, and the testings coded as follows:

Code	Time	Sample
PT	October, 1971	Primary Teachers' college students.
PhxA	June, 1972	Physics students in xth year, testing A.
PhTR	July, 1972	First year Physics students, Test-Retest group, one week after Ph1A.
PhxB	October, 1972	Physics students in xth year, testing B.

To answer the questions set out above, the following comparisons can be made.

4, 5. Not included in the teachers' college questionnaire
6. Not included in the university questionnaire.

Question	Comparison
R1	PT on items 1-6 against item 7.
R2	Ph1A — PhTR for each item.
R3	Ph1A — Ph1B, Ph2A — Ph2B, Ph3A — Ph3B. Ph1B (item 5) — Ph2A (item 4), Ph2B (item 6) — Ph3A (item 4)
Q1	Ph1B — PT for each item, and over all items.
Q2	Ph1B — Ph2B, Ph2B — Ph3B, for each item, and over all items.

In question 2 (Q2), comparisons are made between the B testings as these represent the most informed stage, particularly for the first year students.

The comparisons were made by ranking each potential influence in order of popularity (determined by calculating the percentage of the total 'votes' given to each potential influence), and comparing the ranks so obtained by Spearman's rank-order correlation, rho. Specific differences were identified by comparing the percentage popularity of each potential influence. Caution must be exercised here because of the small numbers involved in the Ph3A and Ph3B groups (43 and 38 respectively). To allow for the sensitivity of percentages to such small samples, only differences greater than twelve percent were called 'significant differences'.

The samples

A full description of the PT (Primary Teachers' College) sample can be found in Docking (1972a). The most relevant characteristics of all groups are summarised in Table 1.

TABLE 1

Summary of sample characteristics

	PT sample	PT pop'n	Ph1A	Ph2A	Ph3A
Sex (percent male)	18	17	77	87	93
Socio-economic status[a] (mean)	4.8	n.a.	4.2	4.3	4.8
Age (years) (mean)	18.6	n.a.	18.6	19.8	21.6
Anderson score[b] (mean)	187	187	216	221	2.9
First year achievement[c] (mean)	256	250	n.a.	n.a.	n.a.
Number	160	317	149	103	43
Percent of population	51	—	96	92	96
Percent wishing to become teachers	—	—	46	34	30

Notes:

Ph1B sample size is 113 (76% of Ph1A)
Ph2B sample size is 84 (82% of Ph2A)
Ph3B sample size is 38 (89% of Ph3A)
a Congalton's seven point scale (1969)
b Sum of best three Higher School Certificate results
c Sum of standardised scores on five subjects
n.a. Not available.

Extensive tests[7] have shown that the PhxB samples do not differ significantly on background or general attitudinal variables from the PhxA samples. From Table 1 it can be seen that the Ph1A and PT groups differ markedly both in their proportion of males and in their mean Anderson score. No significant relationships were found between sex and source of influence, nor between level of achievement and source of influence, within these groups. Thus the Ph1A and the PT groups can be validly compared for the purposes of this study.

Reliability estimates

R1 Do the choices always follow some pattern related to the order given in the list of alternative influences?

On inspection of the PT ranks on each academic item (items 1-6), it was found that there seems to be no definite pattern related to order, although there is quite high similarity between items, suggesting another form of set response pattern. In contrast, the choice ranking for political influence is unique. (The correlation between academic items and political item is .4, which is not significantly different from zero. Lecturers and later year students were far less influential, and outside organisations and non-tertiary peers far more influential on attitudes to politics.) These results suggest that the students are able to answer each item independently, and do no follow set patterns.

R2 Are the students consistent in their responses over a period of one week?

A systematic sample of thirty-five first year physics students (twenty four percent of the Ph1A group) completed the questionnaire a second time. The test-retest reliabilities for each item are given in Table. 2.

TABLE 2

Test-retest reliabilities for each item

Item	1	2	3	4	5	6
Test-retest	.87	.91	.93	.75	.94	.79
Sampling	.91	.91	.96	.90	.86	.93

($p<0.01$ *for all rho*)

The correlations between the Ph1A and PhTR rankings is also given (Sampling) showing that the systematic sample is a representative sample of the whole group. The test-retest correlations are all high, suggesting that the questionnaire has a high reliability. No significant differences in percentage popularity of any influences were observed.

R3a Are the students consistent during the year?

There are grounds to suggest that the students should change very little from the 'A' testing to the 'B' testing. Table 3 gives the A-B correlations for each item for each year.

---

[7] *These are not being reported here but will be published at a later date.*

TABLE 3

A-B comparisons for each year

Item	Ph1A — Ph1B	Ph2A — Ph2B	Ph3A — Ph3B
1	.93	.92	.80
2	.96	.81	.71
3	.92	.96	.85
4	.86	.93	.76
5	.91	.94	.28(ns)
6	.87	.92	.88

($p < 0.01$, except where indicated otherwise)

There was only one significant change in ranking, relating to the influence on the 'choice of course for next year' for third year students (Item 5). (The main differences were the influence of brothers and/or sisters, which was substantially larger, and the lessened importance of a particular lecturer, demonstrators and tutors — lecturers as a group remaining by far the most important.) There were no other significant differences in 'popularity' of influences.

R3b Are the students consistent in their retrospective perception of influences in the previous year?

Item 5 refers to the 'choice of course for next year' and item 4 to the 'choice of course for this year'. A comparison of these specific items across the year boundary should show that Ph1B (item 5) is the same as Ph2A (item 4), and so on for other years. Table 4 represents the results of these comparisons.

TABLE 4

Stability of retrospective perception

Ph1B (item 5) — Ph2A (item 4)	Ph2B (item 5) — Ph3A (item 4)
.86	.93

($p < 0.01$ for both)

These figures indicate that the students are consistent in their perception of the influence on their choice of course before and after they make that choice. There were no significant differences in percentage popularity of each influences.

One can conclude from this and the prior evidence that the questionnaire is highly reliable and thus potentially valid.

Research questions

Q1 What differences are there in perceived sources of influence between first year teachers' college students and first year physics students?

Comparisons between response patterns for the PT and Ph1B groups on the common items (1, 2, 4 and 5) showed no overall difference (Table 5).

TABLE 5

Comparison of PT and Ph1B groups

Item	No.
1	.79
2	.88
4	.64 ($p < 0.05$)
5	.88
All items[a]	.94

($p < 0.01$ except where indicated otherwise)

[a] The total 'votes' for each influence over all items.

While the overall ranking was similar, there were differences in emphasis. Table 6 gives the percentages for influences where substantial differences were observed.

TABLE 6

Major differences between PT and Ph1B groups

Item	Source	PT (%)	Ph1B(%)
1	Lecturers as group	29	20
	Tertiary peers	26	21
2	Lecturers as group	16	9
	School teachers	14	19
4	Lecturers as group	16	1
	School counsellor	9	15
	School teacher	13	31
5	Later year students	16	9
	Particular lecturer	13	3
	Closest three friends	5	12
All items	Parents	10	17
	Closest three friends	17	7

These figures tend to support the hypothesis that PT students would see their lecturers as the most important influences, whereas Ph1B students would tend to see their school teachers as more important. (H1) Differences between items are in accord with the different aims of each item. Item 1 refers to attitudes to the tertiary institution in general, and one would expect peers and lecturers to be important. Item 2 relates to studies, and consequently lecturers and teachers rise in importance. Item 4 refers to choice of course, and naturally, counsellors become significant sources of influence. Later year students, close friends, and particular lecturers have most influence in the choice of the next years studies (item 5) as could be expected. Tertiary peers and parents are consistent influences for both groups on each item.

In summary, the differences between first year primary teachers in training and first year physics students are only in emphasis, not rank, and the differences that exist are consistent with expectations.

Q2 What differences are there in perceived sources of influence between physics students in different years of their courses?

Comparisons on the six items answered by the physics students showed only one significant ranking difference, although there were many differences in emphasis (percentage popularity). Table 7 and Table 8 show the results of the comparisons.

TABLE 7

Comparisons of ranks between years

Item	Ph1B — Ph2B	Ph2B — Ph3B
1	.83	.89
2	.82	.91
3	.86	.84
4	.24 (ns)	.71
5	.90	.47 ($p < 0.05$)
6	.81	.85
All items	.90	.89

($p < 0.01$ unless indicated otherwise)

An examination of the figures in Table 8 shows a number of trends. The first is the increasing importance of the lecturer as a source of influence, as hypothesised earlier (H2). Demonstrators and tutors, who are either research students or lecturers, become increasingly important (item 3) suggesting that the members of the Faculty are being seen as progressively more relevant models. School teachers naturally lessen in importance, along with parents. This is possibly related to a trend which Thielens calls a 'norm of independence', whereby "students not only do not want to admit being influenced by specific authority figures but also display active resistance to such influence as part of their search for independence and discovery of their own meanings in college" (Feldman & Newcomb, 1969). The specific authority figures Thielens refers to are parents, although lecturers may eventually be perceived in the same way. This 'norm of independence' would also account for the observed increase in non-response, which averaged one percent, fourteen percent and twenty-four percent for the Ph1B, Ph2B and Ph3B groups respectively. The great bulk of these nonresponses occurred on items 4 and 5, where, in most cases, the students refused to admit any influences beyond themselves on their choice of course.

Other differences observed are specific to each item and do not indicate general trends. The non-changes are also of importance. Influences on attitudes to "the institution as a whole' do not differ over the years, where one finds that lecturers and tertiary peers (in effect everyone at the institution) share equal importance as influences. The same result is observed when all items are taken together.

TABLE 8

Major differences in percentage between years

Item	Source	Ph1B (%)	Ph2B (%)	Ph3B (%)
1	None	—	—	—
2	Parents	27	18	(22)
	Tertiary peers	11	19	(12)
3	Lecturers as group	19	28	(30)
	Demonstrators and tutors	4	17	(5)
	School teachers	24	14	(11)
	Tertiary peers	7	11	(20)
4	Parents	17	7	(9)
	Lecturers as group	1	20	(26)
	School counsellors	15	4	(4)
	Particular lecturer	1	8	(15)
	Demonstrators and tutors	0	9	(6)
	School teachers	31	9	(4)
	Tertiary peers	5	17	(12)
5	Parents	12	4	(12)
	Later year students	21	14	(3)
	Tertiary peers	9	15	(18)
6	Later year students	8	1	(1)
All items	None	—	—	—

Note: Ph3B figures are in brackets as they do not meet the required difference level from Ph2B figures (12%) but are included to indicate trends as, in some cases, they are 'significantly different' from the Ph1B figures.

In summary, there are few differences in ranking over the years but definite trends in emphasis. These differences are in agreement with the hypothesis stated earlier.

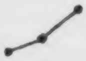
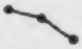
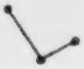
Since it is observed that lecturers become more important as influences, it would be a valuable exercise to determine whether the students become more like their lecturers in later years. An attitude scale developed by the author, tested on the PT group (Docking, 1972c), and since administered to the physics students and staff at university, provides a means to answer this question. The attitude scales measure two main areas, perception of student goals and perception of staff role, at tertiary level. If students begin to identify with the lecturers as they progress, one would expect increasing similarity between the student body and most of the staff in both areas (particularly in regard to student goals) either through a selection, socialisation or a maturation process.

Similarity can be determined between each student and each lecturer by an index such as Cattell's r_p (1969), which ranges from —1 to +1 (similar in distribution to correlation) and can be determined for non-orthogonal (correlated) factors. A full description can be found in other references and will not be given here. Suffice it to say that it is a very sound measure of similarity.

The r_p for each student and lecturer was computed on the goal and role orientation scales, and then averaged for each lecturer over each year, giving a bulk measure of student-staff similarity. Six trends over three years are possible, and these, along with the numbers of staff members with whom the students exhibit these trends for both scales are given in Table 9. This table presents some quite striking information. It is evident that as students progress they 'become' more like their lecturers in their perception of their goals as students, but only after a drop in their second year. The reverse is true of the students' perception of the role of a lecturer. As the students progress they perceive the ideal lecturer role less like the role as seen by the lecturer. In this area it seems that the lecturer is acting as an anti-model, as described by Adelson (1962). Why, then, do they 'become' more like the staff on their percention of their place in the university, and why the drop in the second year? Many first year students

TABLE 9

Trends in similarity between students and staff

Trend from first to third year	Symbol	Diagram	Number of staff with whom students show trend given on	
			Student goals	Staff roles
Steady increase	Ph1A Ph2A Ph3A		6	2
Overall increase after drop	Ph2A Ph1A Ph3A		19	0
Overall increase after greater rise	Ph1A Ph3A Ph2A		0	2
Total increase	Ph1A Ph3A		25[a]	4[b]
Steady decrease	Ph1A Ph2A Ph3A		1	13
Overall decrease after rise	Ph2A Ph1A Ph3A		4	12
Overall decrease after greater drop	Ph1A Ph3A Ph2A		0	1
Total decrease	Ph1A Ph3A		5[c]	26[d]

abcd. Chi-square significant at $p < 0.005$

come to the university fired with zeal to do well and to impress their lecturers and peers. They are the successes of the Higher School Certificate year and see the university in an idealistic way. The second year students are disillusioned and experience what has been called the 'sophomore slump' (Feldman & Newcomb, 1969). (At colleges in the U.S.A. students are called freshmen, sophomores, juniors and seniors as they progress through the four years.) Feldman & Newcomb cite four studies which show that "sophomores are most likely to be dissatisfied with the college and their experience there". It is also reported that at this stage, the students begin to consolidate peer groups. It is evident from Table 8 (items 2-5) that this occurs in Australian universities.

In their third year, the students are nearing the goal of a degree, and return to a realistic view of the purpose of a tertiary institution. There could be a clue to interaction here. If the lecturers lecture and examine in a manner consistent with their views of the purpose of the institution, and interaction of the type sought in the author's major study occurs, then students most like their lecturers will perform better. In other words, some sort of natural selection process would take place. The result would be a third year consisting of students more similar to their lecturers in these attitudes. Such a result is observed. These and other findings will be discussed in more detail at a later date.

In summary, the students do 'become' more similar to most of their staff members in their perception of the purpose of tertiary education, but become less 'like' most of their lecturers in their perception of the lecturer's role.

A review of the results

Two hypotheses relating to the students' perception of sources of influence on their attitude development in the area of academic studies, derived from a consideration of a number of factors, namely the appropriateness of the lecturer as a model, the presence or absence of dissident groups, the continuity of course content from school to tertiary level, the accessability of the lecturer, and the size of class, have been supported by the results obtained. The findings also suggest that a 'norm of independence' trend is present as the students move away from parents, and that the lecturer is seen as an anti-model in relation to his occupational role.

Campbell & McSweeney (1970) show that in secondary school the perceived order of influence is: parents, peers, then teachers, an order that is reversed as the student progresses. Other studies reported by Feldman & Newcomb also show this drift. They conclude that: "The Faculty . . . is clearly seen by the individual students to be of more influence than their fellow students on their intellectual development and on their occupational choice and career decisions." This study must come to the same conclusion. Lecturers are indeed perceived by students as the most significant 'others' in the development of their attitudes to, and choice of, academic studies. There is no evidence that overall perception of the staff member is a critical variable in achievement (Docking, 1972a), but it is clear that the staff members are aware of their importance in the attitude development of their students (Docking, 1972b).

This report suggests that the major study of staff-student interaction will be a rewarding project, adding yet further to the understanding of the complex educational experience at tertiary level.

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INTELLECTUAL ENVIRONMENT
AND
ACADEMIC ACHIEVEMENT
AT TERTIARY LEVEL

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INTRODUCTION

While not always explicitly stated, teacher-student communication is a component of every model of teaching. In view of this, it is surprising to find that very little use has been made of communication theory in research on teacher effectiveness. Studies of student achievement have emphasised student characteristics (intelligence, creativity, personality, and demographic variables, for example); teacher characteristics (such as qualifications, experience, attitudes, teaching styles); or environmental variables (size of classroom, social stratification, sex ratios etc.) (see for example, Feldman and Newcomb, 1969). In general, teacher, student, and environmental characteristics have been lumped together into one regression equation, which achievement as the dependent variable, in a rather haphazard and unstructured way. Debate is usually centred around the appropriate order to introduce the independent variables (Astin, 1970), or ways to allow for the interdependence of independent variables (Feldman, 1970) rather than the validity of such an approach. The assumed relationship is usually

$$A = f(T, S, E)$$

where A represents achievement, T represents relevant teacher variables, S relevant student variables, and E relevant environmental variables.

There seems to be little effort to make predictions about how these variables should interact to 'produce' the dependent variable.

We need to look no further than Gage (1963) for some clues to a refinement of this model. Gage describes a number of models of teaching, which include four models that suggest that student/teacher interaction may be a key to clarification of student achievement research (Mitzel, Smith, Stone-Leavitt, and Runkel). Runkel (1956) takes the concept a step further by recognising that interaction involves interpretation. Teacher behaviors *per se* are not important correlates of student achievement, but the student's perception of them may be. Runkel's paradigm includes a "frame of reference" variable which acts as a perceptual filter, decoding information and observations in a manner consistent with the individual's goals and personality (Murray, 1938; Marks, 1968). From this argument one is encouraged to take the next logical step from learning theory to linguistics. If interpretation is an important variable in student achievement, then communication theory should tell us how it operates. De Vito (1970) describes the relationship thus:

> To the extent that the codes of source and receiver differ, miscommunication will result. The source and receiver who speak different dialects, or even different languages, will miscommunicate to the extent that their codes differ. Put positively, they will communicate successfully to the extent that their codes overlap. In the case of dialects, the misunderstanding may be minimal; in the case of different languages it will be great.

It can also be argued that miscommunication will result in incomplete learning, and incomplete learning in lowered achievement. In short, one can reason that achievement must be a function of code similarity (frame of reference similarity in Runkel's terms), and that this one variable will subsume many of the variables in the equation above. Thus we have

$$A = g(C, t, s, E)$$

where C is the teacher/student congruence variable; t and s represent the remaining relevant teacher and student variables; and E represents the relevant environmental variables.

The importance of congruence in perception has been suggested by other writers, notably Ausubel and Robinson (1969), Baird (1971), Hall (1970) and Jones & Thibaut (1965), and a similar hypothesis has been researched by McKeachie (1961), by Domino (1970) and by Runkel (1956), but the evidence from these studies is not clear. McKeachie showed definite effects on learning related to the interaction of teaching methods and student motives, and Runkel showed that similarity in one form of "cognitive structure" had a significant relation to achievement in psychology. More recently, Domino (1975) has shown that different students benefit more from different teaching methods, and Rowell and Renner (1975) showed a similar effect with examination methods. The question still remains as to whether compatibility of perception in general has an effect on learning and achievement.

We need to ascertain whether the congruence concept results in a significant reduction of variables to be considered, and a significant increase in our explanation of achievement variation. To this end, a research study was begun in 1970. From the outset, problems were encountered in four main areas: the lack of existing theoretical frameworks, appropriate experimental designs and analysis, non-existent measures of appropriate variables, and problems with measures of achievement.

It can be seen from the equation above that one can detect the effect of C on A by either allowing statistically for variables t, s and E, or by controlling them. The problem with the former approach is that one is never quite sure which of many variables to allow for (Astin, 1970), so, if possible the latter approach is preferred.

Remembering that t includes only the balance of the teacher variables not included in C, one can hold these variables reasonably constant by choosing a formalised, standard teaching situation and a range of teachers from a restricted and internally homogeneous discipline. Other uncontrolled variables can be measured and tested for significance. These restricted conditions exist in the traditional university lecture situation in the discipline of Physics. Recognizing that the examination situation is itself a communication exercise (and hence the formula still applies), one can further reduce the t variables by standardizing teacher scores within subjects.

The s variables are much easier to control by treating each student as an experiment conducted with different teachers (repeated treatment design). This approach introduces some problems (such as the interaction of treatments), and the importance of these will need to be sought by different treatment combinations (replications).

E is controlled in effect by the use of a single main communication environment (lecture theatre), although not at random times. The effects of systematic time schedules on achievement will need to be estimated from replications with different groups.

The selection of the University lecture situation for the conduct of this experiment, enables one to reduce the formula to

$A = g\ (C)$ other student, lecturer and environment variables held constant, or measured.

The four main problems are also simplified by this approach.

THEORETICAL FRAMEWORK

Runkel's paradigm provides a suitable framework for this study. In its complete form it has a cyclic nature, representing a dynamic, on-going interaction (see figure 1). Feedback loops illustrate the continuous

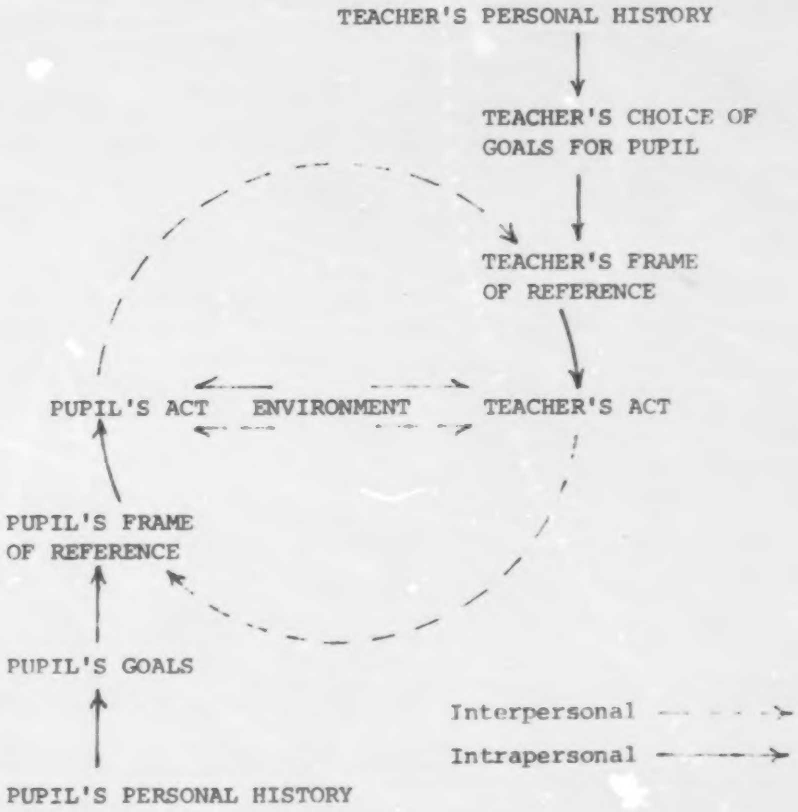
TEACHER'S PERSONAL HISTORY
TEACHER'S CHOICE OF GOALS FOR PUPIL
TEACHER'S FRAME OF REFERENCE
PUPIL'S ACT
ENVIRONMENT
TEACHER'S ACT
PUPIL'S FRAME OF REFERENCE
PUPIL'S GOALS
PUPIL'S PERSONAL HISTORY
Interpersonal
Intrapersonal

Figure 1 - Runkel's Model of Teaching

monitoring by one participant of the other participant's responses. This dynamic and spasmodic nature of the general interaction situation makes it extremely difficult to isolate effects. Fortunately, the lecture situation reduces the interaction to a linear form to some extent. Usually there is very little opportunity for the student to indicate perceptual confusion, or for the lecturer to get immediate feedback from the students. There are, of course, non-verbal cues that the lecturer may perceive, but these too are codes that may be misinterpreted. The only other venue of obligatory staff-student interaction, the examination, is also sufficiently controlled to enable one to employ Runkel's model gainfully. In the examination situation, there is a time-lapse between the teacher's act (setting the examination), the student's response (writing the answers), and the teacher's reaction (marking the answers), preventing oscillatory feedback during each participant's performance. Thus the paradigm takes a simple linear form (similar to the Smith model reported by Gage, 1963) and can be easily applied.

These three situations are illustrated in figure 2.

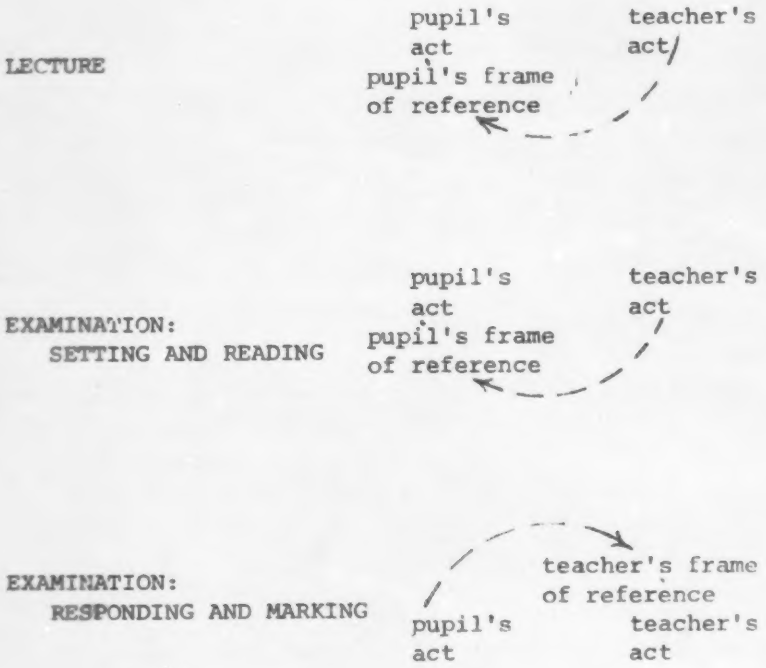
LECTURE
pupil's act
teacher's act
pupil's frame of reference
EXAMINATION: SETTING AND READING
pupil's act
teacher's act
pupil's frame of reference
EXAMINATION: RESPONDING AND MARKING
teacher's frame of reference
pupil's act
teacher's act

Figure 2 - Linear interaction models

There are two further criticisms of this and other paradigms cited by Gage. First, in the typical classroom the teacher deals with more than one pupil at a time, and secondly, there is also student-student interaction, and neither of these situations is accounted for by the models. These are quite serious criticisms, but it can readily be seen that they apply only partially to the lecture situation, and not at all to the examination situation.

On seven criteria described by Deutsch (cited by De Vito, 1970), this paradigm can be shown to be most useful. It organises elements and processes, suggests hypotheses, enables limited predictions to be made, suggests valid measures of its components, and is simple, informative and realistic.

EXPERIMENTAL DESIGN

To a large extent the experimental design has already been specified. A situation has been described in which there is minimum cyclic interaction, minimum environmental variation, and control of student background variables. Each student in a group must experience the same combination of treatments (lecturers); each lecturer must be entirely responsible for each treatment (lecturing and examining); and there must be a sufficient number of students in each group (at least 20).

Page's L-test was used to analyse the results. This is a powerful non-parametric test of ordered hypotheses, developed by Page (1963) related to the Friedman X^2 test. Given hypothesised ranks (drawn from congruency measures, for example) and actual ranks (drawn from achievement measures) one can derive a partial L for each student:

$$L_i = \sum^{n} X_{ij} Y_{ij}$$

and the total value of L can be determined by adding the partial L's

$$L = \sum^{m} \left(\sum^{n} X_{ij} Y_{ij} \right)$$

This reduces to Page's expression

$$L = \sum^{n} (Y_j \sum^{m} X_{ij})$$

in the particular case where the Y_{ij} are the same for all students.

Perceptual congruence was determined from within two scales each of three perceptual test scores (to be described later) in terms of the pattern similarity coefficient r_p (Cattell, 1949). This index is superior to other correlational or Euclidean distance measures in that it takes into consideration the non-orthogonality of factors, the shape, elevation and accent of the profile scores, and the constraints imposed on the distribution by finite scales. Similarity scores for each student with each teacher were derived and ranked.

Test results within each subject in the Physics course were standardized and then ranked across subjects for each student.

The table below illustrates the type of data obtained and the analysis (table 1):

Table 1. Example L test data

Student	Lecturer (subject)					
	A	B	C	D	E	L_i
a	1 / 2	3 / 3	2 / 1	4 / 5	5 / 4	53
b	2 / 4	3 / 2	1 / 3	5 / 1	4 / 5	42
c	2 / 3	1 / 4	5 / 1	4 / 2	3 / 5	38
d	4 / 4	2 / 2	3 / 3	1 / 1	5 / 5	55

L = 188

Significant levels (from Page 1963) $p < .05$ L = 197
$p < .01$ L = 204
$p < .001$ L = 210

One would conclude from the above data that there was no significant relationship between the hypothesised ranks (above each diagonal) and the observed ranks (below the diagonal) because the derived L was less than 197.

MEASURES OF PERCEPTION

The introduction of the congruence variable, C, simplified the equation because C was a function of the teacher and student variables.

$$C = h(T', S')$$

We already defined the congruence function in terms of Cattell's coefficient of similarity ^{r}p - the task now is to define the variables T' and S'.

One could compare students and staff on a wide range of variables, but as their roles differ so markedly, one is unlikely to find many variables where there is sufficient overlap between student and staff score profiles. One way to overcome this difficulty is to use two classes of variables, one relating to student goals, the other to staff roles and submitting both scales to both groups. Congruence measures were determined within scales not across scales. Only the introduction to the questionnaires differed with staff and student forms (see table 2).

Table 2. Scale operations

	Student goal orientation scales	Staff role orientation scales
Students (S)	Self perception	Perceived ideal staff
Staff (T)	Perceived ideal student	Self perception

- Student goal orientation (SGO) was determined from three factors: intellectual activity, diversity of intellectual activity, and acceptance of externally set standards or goals. These scales were derived from the original 'subcultural' typology of Clark and Trow (1966).

- Staff role orientation (SRO) was derived from a typology of Clark (1966) and reflects the three main roles performed by university academic staff: preoccupation with students, preoccupation with pure research, preoccupation with the institution.

Dichotomising each of these scales one can identify eight potential types, illustrating that any profile is possible (see table 3).

Table 3. Extreme Scale types

STUDENT GOAL ORIENTATION SGO (Amount, Diversity, External)		STAFF ROLE ORIENTATION SRO (Administration, Students, Research)	
(H,H,H)	Scholar	(H,H,H)	Teacher/Researcher/ Administrator
(H,H,L)	Intellectual	(H,H,L)	Teacher/Administrator
(H,L,H)	Academic	(H,L,H)	Researcher/Administrator
(L,H,H)	Dilettante	(L,H,H)	Teacher/Researcher
(H,L,L)	Vocational	(H,L,L)	Administrator
(L,H,L)	Flitter	(L,H,L)	Teacher
(L,L,H)	Swot	(L,L,H)	Researcher
(L,L,L)	Misfit	(L,L,L)	Misfit

In practice, neither students nor teachers fall into such clearly defined groups, although cluster analysis identified 8 groups for the SGO scales and 6 groups for the SRO scales. Studies conducted by Baird (1969), Saviki et al. (1970) and Ellis et al. (1977) have demonstrated that students who identify with certain of these or similar sub-groups perform differentially, generally in the order Non-conventional, Academic, Vocational and Collegiate. Similar analysis with the groups obtained by cluster analysis also showed achievement differences, but these were independent of interaction effects.

The scales devised to measure the six variables in the SGO and SRO scales were constructed using items from a wide range of sources, including the work of Katz and Katz (1968), Katz, Magin and Arbib (1969), and from studies reported by Feldman & Newcomb (1969). Likert scales of ten items each were eventually formed after pilot testing with a sample of 160 students from a C.A.E. The items are statements of attitude to which students responded on a four-point scale. Extensive validation was subsequently conducted on the scales, and they were found to be performing at a most satisfactory level.

Table 4. Scale Characteristics

Scale	Test - retest (1 week)	Test - retest (4 months)	Cronbach's α	Validity
Amount	.71	.66	.45	Measures of content validity, and construct validity (from predicted correlations, group characteristics, inter-item and inter-test correlations etc.) were studied. All evidence supported the validity of the scales. Overall, the Administration scale performed marginally, but this may reflect the sample used in validation (the students) rather than actual scale characteristics.
Diversity	.83	.83	.69	
External	.84	.68	.70	
Administration	.69	.62	.40	
Students	.95	.81	.66	
Research	.85	.74	.61	
	N = 35	N = 43	N = 287	

Each item has a moderate correlation with its factor (not too high, because then the item would be redundant) and has a very low correlation with other factors. Scales made up of items with these characteristics are called factor pure scales (Cattell and Warburton, 1967), providing the greatest scope for maximum validity. The scales were designed to be applicable to any tertiary student group, and have proven valid with such widely different groups as Physics Students and Primary Teacher Trainees.

That these scales met the requirement of staff-student overlap is demonstrated by the means and ranges of these groups on the scales (see table 5).

Table 5. Staff-student overlap

Scale	Staff (N=28)		Students (N=287)	
	Mean	Range	Mean	Range
Volume	30.91	27 - 36	28.4	20 - 36
Diversity	28.0	20 - 33	28.6	16 - 35
External	26.21	11 - 32	24.5	10 - 34
Administration	25.0	15 - 30	24.6	15 - 30
Student	29.3	19 - 35	29.2	18 - 35
Research	25.91	18 - 33	25.6	17 - 37

MEASURES OF ACHIEVEMENT

The theoretical framework suggests that the assessment of a student is a staff/student communication/interaction exercise, and hence is consistent with the research. Errors in interpretation of questions by the student or answers by the teacher are artefacts of interest, not errors to be avoided. For this reason, the most valid form of assessment is that conducted by the lecturer without interference from the researcher. No independent measures of achievement were administered. The only investigation of the examination process was a study of the types of questions asked (on the basis of Bloom's taxonomy, 1956) to determine if any significant differences existed between examiners (lecturers). If such differences did exist, this could, in part, account for variations in achievement of individual students. As no such differences were found, any interaction between staff and student must be regarded as operating in another dimension.

ANALYSIS AND FINDINGS

The sample

Two hundred and eighty-seven students majoring in Physics were administered the SGO and SRO scales in June 1972. This constituted 98% of the population of students. Thirty of the thirty-one staff responded to their questionnaires at the same time. The questionnaires were re-administered to the students just before the final examinations (October 1972) by mail, and 82% of the first sample responded. The distribution of subjects by year and course are given in table 6.

Table 6. Distribution of Sample

Course Physics	No. of different Lecturers	Population	First admin. (%age of population)	Second admin. (%age of sample)
101	-	153	97	77
201	7	40	98	91
203	5	57	95	93
301	10	21	100	95
303	7	23	96	95
Staff	-	31	97	-

Assumptions

A major assumption in the research design is that the student's perceptual frame of reference is relatively unchanged over a semester of study. This is partially confirmed by the test-retest data given earlier (table 4), but this does not consider the more relevant and important question - does the student change significantly on SGO or SRO scales as a whole? Using the similarity indice ^rp described earlier, we can compare a student (first administration) with himself (second administration) and ascertain whether significant shifts have occurred.

In order to assess whether observed ^rp's differ significantly from ideal, one can draw cumulative frequency curves for $^rp = 1.0$ (making allowance for errors of measurement), $^rp = .9$ and $^rp = 0$.

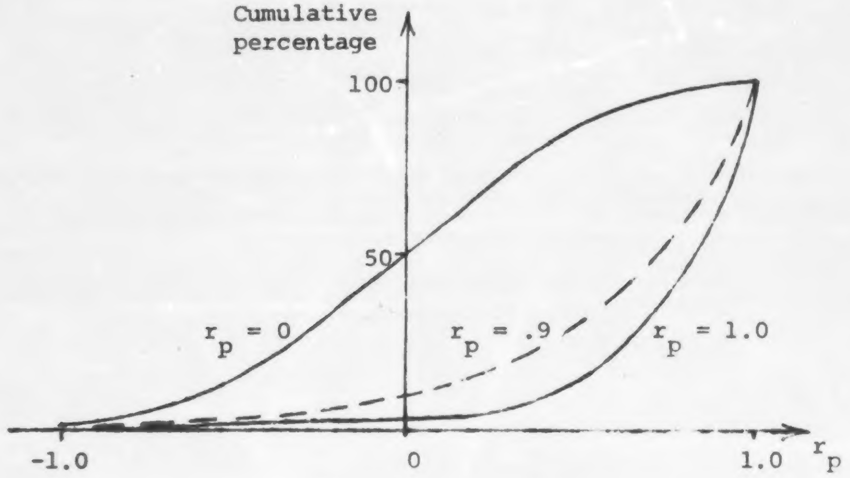

Figure 3. Distribution curves of ^rp.

The distribution curves of ^rp for each physics group and for each scale were plotted (see figure 3). Generally, the curves lay in the area enclosed by $^rp = .9$ and $^rp = 1.0$. Using the Kolmogarov-Smirnov test one can test the hypotheses $^rp = 1.0$, $^rp = .9$ and $^rp = 0.0$. Table 7 gives the results.

Table 7. Self similarity indices (^{r}p) for year groups

Physics group	Scale SGO	 SRO
First year	.9	.0
Second year	.9	.9
Third year	1.0	1.0

Maximum value of ^{r}p confirmed by Kolmogarov-Smirnov at $p < 0.05$.

These figures indicate that the students did not change significantly, particularly the third year students, and particularly in the SGO scale. First years, quite logically, changed the most. Given that changes were insignificant, data obtained from the first administration was used to test the hypotheses.

Results

The main hypothesis to be tested is that there is a significant positive relationship between student/lecturer congruence and student performance with that lecturer. In statistical terms, this could be demonstrated by a value of L significant at the .05 level determined from congruency ranks and achievement ranks.

The L values and levels of significance are given in table 8.

Table 8. Page's L values for groups on both scales

Student group[+]		SGO	SRO
Physics 201	M = 33 n = 7	3857**	3604
Physics 203	M = 47 n = 5	2196**	2103
Physics 301	M = 20 n = 13	13,168*	12,615
Physics 303	M = 20 n = 7	2212	2154

* $p < .05$

** $p < .01$

[+] Physics 101 were not tested for congruence because of the lack of one-to-one correspondence between lecturer and examiner.

The hypothesis was supported in general for SGO congruence, but not for SRO congruence. The Physics 303 group result is not entirely surprising as this course requires the students to take three compulsory physics units and select four other physics units from ten remaining. In all other groups, all units were compulsory, and therefore all students experienced the same treatment combinations (a requirement of the analysis technique!)

The hypothesis was not supported for SRO congruence by any group. Quite clearly, Staff Role Orientation as defined and measured in this study, is not an important staff/student interaction variable in terms of learning outcomes. This is a one-tailed test, and later evidence suggests that there might be some returns in future studies from the alternative hypothesis that staff/student incongruence has a positive relationship with student achievement!

CONCLUSIONS

The evidence presented above has implications for teaching and for further research. Quite clearly, there are important interaction effects that a lecturer must be aware of when teaching and testing students. These effects suggest that time spent on clarification of goals, sharing perceptions, and personal contact would be time well spent, as it would enable the development of mutual understanding of each participant's 'frame of reference'. Team teaching, while not eliminating the effect, may reduce its impact on achievement, and hence appear fairer. Student choice of lecturer and examiner, or lecture technique and examination technique may be a solution, but the evidence to date suggests that they are likely to make unwise choices on inappropriate criteria (Rowell and Renner, 1975). Compulsory streaming into optimum technique/student groups may produce results (Domino, 1975) but could be a controversial practice on ethical grounds.

It could also be argued that this interaction effect is a necessary and desirable one. Perhaps there are a limited set of cognitive structures suitable for successful professional physicists, and the interaction serves to "weed out" those who do not fit. Longitudinal evidence (from the three years tested) seems to support this, in that the students tend to be more like their lecturers on the SGO scales in later years (Docking, 1973). It seems that some form of selection, socialization or maturation is taking place. Stability measures described earlier suggest that the first of these processes is the most likely cause of the trend of growing similarity. In contrast, the students are less like their lecturers in later years in the SRO scales, suggesting an anti-model effect. Given that most of the undergraduate physics students were teachers in training, it is not surprising that they did not identify closely with the professional, research oriented physicists. Provision for this fact by staff would be of benefit to students, as an awareness of the differing needs of students would result in more flexible and realistic goals and activities.

In summary, staff-student communication both formal and informal, plays a vital role in learning. There must be opportunity for feedback, for flexibility, and hence for fairness. These are not new suggestions, but often empirical evidence is needed to stress their importance.

A number of distinct lines of research can be suggested for further study. Modelling effects in professional schools or faculties could be studied using the SGO and perhaps the SRO scales. Interaction effects in other, less structured learning environments could be measured. Observable teaching/learning behaviors might be correlated with SGO and SRO profiles - perhaps revealing mechanisms of interaction in the classroom previously undetected. There are many areas of research on teaching styles, learning styles, and assessment techniques that could be based on SGO and SRO scales.

The methodology that led to the results reported is itself interesting, and could have wide application to other studies of interaction, communication, and linguistics.

The lack of opportunity for two-way communication in the lecture environment has subtle and undesirable side effects that surface in student achievement. The lecture situation is well known to be an inefficient learning environment for a wide range of objectives, and the evidence presented further invalidates its use. At a time when lecturing is still the standard teaching technique at tertiary level, further evidence of its specific weaknesses may serve to define sharper boundaries of its proper use in higher education.

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CORREGENDA STAFF-STUDENT INTERACTION AT TERIARY LEVEL R.A.Docking 1976

Please note the following typographical errors, shown as :

corrected word (page number, line number).

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